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PUBLIC WORKS MINISTRY.

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# REPORT

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UPON THE

ADMINISTRATION OF THE PUBLIC WORKS DEPARTMENT

FOR 1900

BY

SIR W. E. GARSTIN, K. C. M. G.,

*UNDER SECRETARY OF STATE FOR PUBLIC WORKS DEPARTMENT*

WITH REPORTS BY THE OFFICERS IN CHARGE OF THE SEVERAL BRANCHES  
OF THE ADMINISTRATION

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## PUBLIC WORKS DEPARTMENT.

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# ADMINISTRATIVE REPORT FOR THE YEAR 1900.

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The present Report, like those of preceding years, contains a, more or less, summary account of the work done, and the progress made, by the Department of Public Works, in the year 1900. To it, I have appended the Reports which have been addressed to me by the heads of the different Services attached to the Ministry of Public Works. These Reports explain the working of the different branches of the Administration, and are full of interesting detail. They form valuable records and as each of them is written by a specialist, the information they contain is well-worth perusal.

The following is a list of the reports appended to my own:—

### I.—*The Irrigation Branch.*

- (a) Report by Mr. K. Verschoye, Inspector General of Irrigation, Upper Egypt.
- (b) Report by Major Brown, C.M.G., Inspector General of Irrigation, Lower Egypt.
- (c) Report by Mr. A. L. Webb, Director General of the Nile Reservoir Works.

### II.—*Works other than Irrigation.*

- (d) Report by Mr. A. H. Perry, Director General of Towns and Buildings.
- (e) Report by Captain H. G. Lyons, Director General of the Survey Department.

- (f) Report by Mohamed Bey Anis, Chief of the Technical Service.
- (g) Report by Monsieur G. Maspéro, Director General of the Antiquities Department.
- (h) Report by Mr. A.J. Cotterill, Engineer in Chief of the Railway Administration, and Acting Inspector to the Ministry of Public Works, for the Agricultural Railways.

The following tables show the total expenditure, under the Public Works Budget, in 1900:—

TABLE I.

ORDINARY BUDGET.

	£E.	Mill.
Central Office... ..	40890	170
Irrigation Branch... ..	662231	422
Towns and Buildings... ..	221398	956
Survey Department... ..	17691	638
Technical Service... ..	14277	422
Antiquities Department... ..	11953	798
Total... ..	£E.968443	406

TABLE II.

EXTRAORDINARY BUDGET, I.E., NEW WORKS EXECUTED UNDER SPECIAL CREDITS.

	£E.	Mill.
New Weirs (money granted by the Caisse)... ..	182260	305
Special Drainage Works (money granted by the Caisse)... ..	168226	542
Special Irrigation Works (money granted by the Caisse)... ..	118796	041
Public Buildings (money granted by the Caisse)... ..	152070	000
Public Buildings (money found by other Departments)... ..	12154	074
Total... ..	£E.633506	962

In addition to the expenditure shown in Table II, certain further sums were spent upon miscellaneous items, other than new Irrigation Works and Public Buildings. The credits for these were derived from various sources. I have grouped this expenditure into a separate Table, which I have called "Various extra credits."

TABLE III.

VARIOUS EXTRA CREDITS.

	£E.	Mill.
Special credit for Low Nile (granted by the Caisse) ...	12985	000
Dredging Mahmudyieh Canal (granted by the Caisse) ...	3882	182
Earthen dams in Rosetta and Damietta Branches (granted by the Caisse) ... ..	14343	926
Catalogue for Egyptological Museum (granted by the Caisse) ... ..	1340	117
Repairing the Karnak Temples (granted by the Caisse)	3466	409
Land Surveys (granted by Finance Ministry) ... ..	17422	000
Removal of sudd in Bahr el Gebel (granted by Finance Ministry) ... ..	10000	000
Revenue from Barrage Gardens (granted by Finance Ministry) ... ..	887	466
Revenue from Cairo City (granted by Finance Ministry)	5131	314
Revenue from Ezbekieh Gardens (granted by Finance Ministry) ... ..	17	668
Expenditure on Provincial towns (granted by Finance Ministry) ... ..	142	440
Scavenging and Watering Service (Extra credit granted by Finance Ministry) ... ..	1468	194
Total... ..	£E.71086	716

TABLE IV.

TOTAL EXPENDITURE IN 1900, UNDER TABLES I, II AND III.

	£E.	Mill.
Ordinary Budget ... ..	968443	406
Extraordinary Budget ... ..	633506	962
Various extra credits ... ..	71086	716
Total... ..	£E.1673037	084

The above does not include the payments made, for the Nile Reservoir Works, to Sir John Aird & Co.

The total value of work executed in connection with the new Reservoir, in 1900, was £1000293, or £E.975285,675 mill. If this sum be added to the figures given in Table IV, the total expenditure controlled by the Ministry of Public Works, in 1900, attains a total of £E.2648322,759 mill.

I will now proceed to briefly discuss the work done by the several services in 1900; separating it, as has always been my custom, into two classes, viz., "Irrigation Works," and "Works other than Irrigation."



## Part I.—THE IRRIGATION SERVICE.

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### THE NILE SUPPLY IN 1900.

The year 1900 was, in many respects, a remarkable one. The supply in the river, during the early summer months, was exceptionally low. The flood arrived early and, at one time, promised to be a good one. The expectations formed, however, proved delusive and the fall commenced in the third week of August. From that date, it was practically continuous. The flood of 1900 must consequently take its place in the category of those marked as "Poor" ones.

On the 1st of January, the Aswan gauge registered a height 1·78 metres, below the average of preceding years. Up to the 15th of May, the fall in the river levels was both rapid and sustained. On this last date, the Aswan gauge recorded four kirats below the zero mark, or nearly one metre lower than the mean lowest gauge of twenty years. Even in the bad years of 1878 and 1889, this gauge had never registered so low a level.

On the 27th of May, a slight increase was recorded. After this date, the rise was regular, and was maintained, with but few breaks, until the 19th of August, when the maximum level of 16 pies 5 kirats was attained. On the following day, the fall commenced and, although slow, was, with the exception of two feeble rises in September, practically continuous to the end of the year. From the 7th of October, the river fell rapidly.

There has been some discussion as to whether the average discharge of the river, during the summer of 1900, was below or above, that of the year 1889. If the Aswan gauge register be accepted as correct, the average levels of 1900, were considerably lower than those of 1889. There appears, however, to be little doubt that, from some cause unknown, the readings of this gauge, last summer, were misleading, and were slightly below those corresponding to the actual supply in the river. Major Brown has discussed this question in considerable detail, in an interesting Note, appended to this Report. He considers that the mean level, recorded by the Aswan gauge in 1900, was 0·35 metres lower than should have been the case, taking into account the volume of water actually passing down the river. He supports this theory by a comparative statement of discharges. He, further, arrives at the

conclusion, that the average discharges of the river at Aswan, in 1900, were, from the beginning of January to the end of May, less than those of the same period in the year 1889, but that, in June and in the first half of July, the supply, at Aswan, was poorer in the year 1889, than it was during the same months of last year. He has endeavoured to make his comparison an impartial one, and I consider that he has fairly proved his case. There must, nevertheless, always be an element of uncertainty in any such comparison. Discharge measurements of a river, especially when observed in a wide channel, where the depth of water is small and the velocity low, are not always to be implicitly relied upon. In the case of the Aswan discharge, moreover, many of the figures are based upon assumption, being calculated from tables, compiled from a certain number of registered discharges. Although, then, it appears to be fairly certain, that the Aswan gauge, in 1900, recorded too low a series of readings, during the period of poorest supply, the amount of the correction to be applied, cannot be stated with absolute confidence.

The question, although interesting, is not one of paramount importance. I do not think that the landowners of Egypt are likely to feel an overwhelming interest in any discussion as to whether the average water-levels of last year were a few centimetres above, or below, those of 1889. What, I imagine, must appeal to them far more, is the fact, that, in spite of an abnormally low river, a cotton crop, only surpassed in quantity by those of three previous years, was secured to them in 1900. They have shown, by the congratulatory addresses presented to the Ministry of Public Works, that they understand that this result was due to the measures taken by the Irrigation Service, to ensure an economical distribution of the scanty supply of water, and also to the steady progress in irrigation improvements, which, thanks to a liberal yearly budget allotment, has been made throughout the country for many years past.

Whatever may be the case regarding the comparative discharges of the last two years of bad supply, there can be no question that the supply of 1900, if not actually the lowest known, must be classed as one of the lowest of which there is any record. The flood of 1899 was a very poor one, and as has been shown, the rapid fall in the levels was continued well into the summer months of the following year. The water surface of the Victoria Nyanza lake had fallen considerably below the registered height of previous years. The White Nile had shrunk to such small dimensions as, in places, to be impassable, for anything but native boats. The channel, between Wadi-Halfa and Aswan, was almost unnavigable, even for light-draught

steamers. The river traffic, north of Aswan, was only carried on with the greatest difficulty. Every thing seemed to point to a year worse than any hitherto known. The anxiety, in Egypt, regarding the safety of the cotton crop, rose to an extreme pitch, and disastrous speculation resulted. Fortunately, towards the end of May, the situation changed for the better. This improvement was due to several causes.

Between the months of January and March, Major Peake had removed the sudd blocks in the northern reaches of the Bahr-el-Gebel. The water in the shallow lagoons, which adjoin this river, had been held up by these blocks and, as soon as they were removed, drained into the channel. As each successive obstruction was cleared, a corresponding, but temporary, rise took place in the levels of the White Nile. Little, if any, of this surplus water found its way to Khartoum, as most of it was wasted in Lake No, and in the huge marshes which, for hundreds of miles, border the White Nile, upon either side. The supply from the lagoons, moreover, was not inexhaustible, and ceased as soon as their water-levels coincided with those of the Bahr-el-Gebel. Notwithstanding this, the removal of the sudd had an important influence upon the summer supply of Egypt. These lagoons are connected with the Bahr-el-Gebel by numerous channels. Consequently, after their surplus water had drained off, they acted as reservoirs which supplied the river and prevented any further serious fall in its levels. In the last ten days of April, a timely rise, of two feet, occurred in the Blue Nile at Roseires. This was followed by another, and still higher rise, on the 11th of May, and by continual flushes during the remainder of that month. Meanwhile, in the latter half of April, the Sobat began to rise. By the 4th of May it had risen 0·70 metres at Nasser and by the 19th of that month, 1·99 metres, thus bringing a welcome addition to the volume of the White Nile. In May, the Khartoum gauge began to rise, very slowly at first, but more rapidly later, as the volumes of the Blue Nile, and of the Sobat, increased.\* This early rise, coming at the time it did, was of the greatest assistance to Egypt, and enabled the Irrigation Service to tide over the most critical period of the season. In this respect, then, the year 1900 was more favoured than was 1889, when no early rise occurred to relieve the situation. In spite of this, however, Lower Egypt was, as Major Brown shows, but little, if at all, better off in 1900 than it was in 1889. The foundations of the new weir, at Assiout, had involved the construction of earthen dams across the river, at that place. These dams held up the water, increas-

\* The Upper Nile appears to have played a very small part in the flood of 1900, the rainfall in that region having been extremely scanty.



ing the supply of the Ibrahimieh canal, but decreasing the amount which passed down the Nile, to Cairo. Efforts were made to counteract this diminution, by opening the Deirut Escape, and thus discharging a portion of the Ibrahimieh water back into the Nile. This measure was only partially successful, and Middle Egypt, and the Fayoum, undoubtedly benefitted at the expense of Lower Egypt. In consequence of this fact, and taking into account the large area of cotton that was in question, it is doubtful whether the Provinces, north of Cairo, have ever passed through a period of severer strain than was the case previous to the arrival of last year's flood. To add to the difficulties, the large reservoir, formed in the Damietta Branch (upstream of the earthen dam placed in the river near its mouth) began to fail at the end of June. The springs in the bed apparently stopped working. The pumping stations upon the river banks, which had previously drawn their supply from this reservoir, were consequently unable to do so any longer, and were obliged, wherever possible, to avail themselves of a share of the very scanty volume of water passing down the canals parallel to the Nile. Happily, this state of things was not of very long duration and, by the 20th of July, the discharge of the river was sufficient to permit of the prohibition regarding early sowing of the maize crop being removed.

The flood, as has already been explained, was a poor one, in spite of the early rise, and reached its maximum on the 19th of August. Although, then, the levels in the first half of that month were most favourable to Lower Egypt, the contrary was the case in Upper Egypt, as the date of the maximum height attained by the river was almost coincident with the opening of many of the basin chains. The early fall rendered it extremely difficult to ensure that the different systems should be filled with water to the level known as "Tamam Rai," or Complete Irrigation.

The "Sarf," or emptying of the Basins, commenced on the 2nd of October, in the Province of Girga. In other localities, it was some three days later, but was completed, for the whole of Upper Egypt, by the 21st of November. The "Sarf" operations were greatly retarded by the measures necessitated for passing on the water of the different basin-systems from one to another. Only by such means, was it possible to ensure the irrigation of the whole area.

One feature, in connection with the year 1900, deserves mention. In the early summer months, Lower Egypt was called upon to meet the heavy strain due to the poor river discharges, while Upper Egypt, *i.e.*, those portions of it under "Sefi" culture, enjoyed a comparatively easy time. With the arrival of the flood, the conditions were reversed.

The difficulties, with regard to irrigation, in Lower Egypt ceased, while those of Upper Egypt only commenced with this event. Both regions, therefore, had, in turn, to bear their share of the pressure caused by a continuous low Nile supply.

#### SPECIAL MEASURES TAKEN FOR WATER DISTRIBUTION.

Early in 1900, it was felt that very special measures would be required if the cotton crop of Lower Egypt was to be saved. The most important of these were the following:

(I). The heads of the main canals taking off the river, upstream of the Barrage, were carefully regulated upon, so as to ensure a distribution of water, proportionate to the area of land to be served by each.

(II). Temporary earthen dams were made, near the mouths of the Rosetta and Damietta Branches of the Nile, in order to prevent, as far as possible, any ingress of sea-water into the river channel.\*

(III). Special programmes of canal rotations were drawn up and published early, so that every one interested might have time to study them and make his arrangements accordingly. These programmes were divided into three classes, increasing in severity, as the season advanced, and as the river fell. The first allowed for one watering in twenty days, the second, for one watering in twenty-four days, and the third, for one watering in twenty-eight days. These rotation schemes were drawn up entirely with a view to saving the cotton crop, and with a disregard of the rice crop. It was understood by everybody that it would be practically impossible to save both crops, and that, the cotton being by far the more valuable of the two, all efforts should be devoted to its preservation. The consequence was, that little, if any, rice was sown. The people in the low lands, to the north, however, recouped themselves to a considerable extent by substituting cotton for rice. In many instances the crop was a good one, but these lands, being poor and salty, could not stand any frequent recurrence of such a practice.

(IV). A Khedivial Decree was published, prohibiting the early maize sowings, until such date as the Ministry of Public Works should permit of them. This prohibition was necessitated by the state of the river. The area of land, yearly cultivated with maize in Lower Egypt, is, roughly speaking, nearly three times as great as that cultivated with cotton. Previous to the restoration of the Barrage in 1890, the former crop was never sown until the arrival of the flood, for the good reason, that sufficient water was not previously available. With an improved

\* The Damietta Branch \* sudd had not been made since the year 1889, or that in the Rosetta Branch, since 1894.

distribution, the dates of planting maize have been gradually advanced, and, at the present time, landowners endeavour to put in this crop as early as is consistent with its coming to maturity. Even in years of good supply, this practice throws a heavy strain upon the resources of the Irrigation Service, as the area of land requiring water is suddenly trebled, while the supply in the river, if not actually decreasing, is stationary. The consequence is, that the rotation machinery is thrown more or less out of gear, and the maize crop is watered at the expense of the cotton and rice. In a year like 1900, it would have been fatal to have permitted the early sowing of maize upon a large scale. It was therefore decided to postpone this cultivation everywhere, until such time as the increased discharge permitted of it, without injury to the cotton. Permission to sow maize, generally, was given on the 23rd of July, and the results have proved that no hardship was entailed, the crop of 1900 having been a very good one.

(V). In order to increase the discharge of the Mahmudiyah canal, upon which the town of Alexandria is dependant for its water-supply, the pumps at Atfeh, on the Rosetta Branch, were worked in the months of June and July, raising an average af from 1 to  $1\frac{1}{2}$  millions of cubic metres per diem.

Special temporary pumps were also erected at Kebrit, in the Gharbiyeh Province, to draw water from the river. Between the 19th of June and the 29th of July, they irrigated an area of 5,000 feddans the crops on which must otherwise have perished.

(VI). A large temporary staff was employed, whose duties were to continually patrol the canals and to see that the rotations were strictly enforced.

(VII). With the rising river, the Barrage was regulated until the upstream level stood at 15.50. It attained this height upon the 30th of July, *i.e.*, 12 to 15 days earlier than the usual date at which this level is reached.\* This was only rendered possible by the completion of the new weirs, downstream of the Barrage, which were so far advanced that it was possible to hold up water upon each, and thus raise the upstream levels, without increasing the head upon the Barrage to a dangerous amount. Thus, in the first year of their existence, these weirs justified the money spent upon them. With their assistance, it was possible to take full advantage of the early rise of the river, and to so increase the supply in the canals, that the maize crop was planted in good time, and yet no detriment was caused to the cotton crop.

(VIII). Lastly, a special credit was applied for, and granted, in order

\* The level of 15.50 had never previously been arrived at in the month of July.

to enable the different measures to be put in force. The total expenditure, under this head, amounted to £E.29865, including the construction of the Damietta and Rosetta sudds, and the dredging of the Mahmudiyah canal.

As the river rose, milder rotations were applied in Lower Egypt, and by the 12th of August all difficulties has ceased.

In Upper Egypt, as has been before mentioned, the difficulties of irrigation only commenced with the flood. During the summer, the supply in the Ibrahimiyeh canal was rather better than usual. Rotations were enforced, but not in a severe form. They commenced, in certain localities, on the 19th of February, and were imposed, generally, on the 10th of March. In the months of June, the Fayoum supply was deficient for a short period, but even this temporary scarcity disappeared with the arrival of the early flood.

The filling of the basins, and the bringing the water up to the required level, was a work which required very skilful management. Mr. Verschoyle, in his report, gives an interesting description of the measures taken for the distribution of the water. I will, consequently, very briefly allude to them here. The filling of the southern basins (Provinces of Assuan and Kenh), which are fed direct from the river, commenced on the 6th of August. There being no means in these localities of feeding one chain, by passing on the water from another, higher up, the water-level in some of the basins fell short of "Tamam Rai" by from 0.70 to 1.35 metres. The result was that an area of 8,219 feddans was left "sharaki" or un-irrigated.

In Girga Province, the Nile escapes were used, as far as possible, as feeders, but, to show how great was the strain, it may be mentioned, that the basins of southern Sohag did not receive their full supply level until the 14th of October. In an ordinary year, they would have been emptying their water back into the river by that date. Notwithstanding the low flood levels, the total sharaki area in this Province did not exceed 1,200 feddans.

In the Province of Assyut and in those to the north, the basins were opened between the dates of the 10th and 18th August. The water was passed on, through one series to another. The total area of Sharaki in Assyut, Minieh and Beni-Suef was 7,042 feddans. The un-irrigated area, for the whole of Upper Egypt, was consequently 16,461 feddans. Of this amount, however, 12,796 feddans was on islands and on foreshores, outside of the Nile banks, which from natural causes, were beyond any help from the Irrigation Service.

In the Ghizeh Province, in which are situated the most northerly of the basin chains, the irrigation operations were, on the whole,

successfully carried out. This result was largely due to the improvements in the systems which had been carried out before the flood. In south and east Ghizeh, there was, however, a tract of high land which the flood water could not reach. The area thus left unwatered was 4,000 feddans, but some portions of it were irrigated artificially.

Taking into account the exceptional nature of the Nile supply, throughout 1900, I think the officers of the Irrigation Service have good reason for satisfaction, when they look back upon the results of their last year's work. They were called upon to combat a low summer supply and a poor flood, successively. They succeeded in saving a magnificent crop of cotton, and in securing the irrigation of the basin lands, which raise the wheat crop of the country. Where all have worked so well, it is perhaps invidious to make any selection, for special mention. I most, however, cordially endorse Major Brown's words of praise regarding the work of the three Inspectors of Irrigation, in Lower Egypt, viz., Messrs. Langley, Verschöyle, and Dupuis.

In a period like that of the summer of last year, it is upon the Inspector of Irrigation that the chief burden must necessarily fall. The general scheme of distribution may be worked out by his chief, but the Inspector is responsible for carrying it out, and for ensuring an equitable distribution of the water. No one, who has not actually held the position of Inspector of Irrigation in a year of low supply, can realise how severe is the strain which is thrown upon him during the summer months. Those who have passed through this experience will appreciate the work done by the three gentlemen above-mentioned. As regards Major Brown, the Inspector General of Irrigation in Lower Egypt: when I say that, in addition to the onerous duties of supervising and directing the general arrangements for water distribution, he personally superintended the construction of the weir in the Rosetta Branch and completed it, in one season, I have given a faint idea of the work which he was called upon to do last summer.

Turning to Upper Egypt; here again, the work of the Inspectors of Irrigation deserves special mention. Mr. Clowes in the 4th Circle, Mahmud Bey Sidky in the 5th, and Hussein Bey Wassif, in the Girga Directorate, each and all of them, laboured energetically and successfully, to avert the possible consequences due to a low flood. To their efforts is due the fact, that there was so little unirrigated land in Upper Egypt. Mr. Clowes acted as Inspector General of Irrigation in Upper Egypt throughout the period of flood, and he deserves the fullest credit for the success of his season's work.

The Irrigation Officers were seconded in their endeavours by the Mudirs, and by all the District officials, in the most loyal manner.

Without their help, success would have been difficult, and even doubtful. The people, as a whole, showed a much greater respect for the regulations than they had ever done before.

# CROPS IN 1900.

## *The Cotton Crop.*

Notwithstanding the poor supply, the crop of 1900 was a large one. Had it not been for the abnormally cold weather and the fogs which lasted throughout the month of September, at the moment when the cotton pods were ripening, there is little doubt that the yield would have been an exceptionally large one, even if it had not surpassed all previous records.

The following is the comparison with the crops of previous years:—

YEAR.	Amount of Crop in kantars.	Average price reached per kantar for the whole season.
		P.T.
1888	2,699,103	272·5
1889	3,200,000	268·0
1890	4,100,100	227·0
1891	4,500,000	178·0
1892	5,200,000	187·0
1893	5,200,000	178·5
1894	4,550,000	192·5
1895	5,203,650	223·9
1896	5,785,532	191·5
1897	6,513,444	162·9
1898	5,579,602	183·2
1899	6,432,776	258·2
1900	*5,500,000	267·7

The average rate per kantar, from September, 1900, to the end of February, 1901, was 289·9 P.E., which is higher than that of any of the years above given. In the months of December and January it reached 300 P.E. the kantar; after February it fell, but as the small proprietors were obliged to sell early, in order to pay their land-tax, they realised the benefit of the high prices.

Comparing the value of the crop of 1900, with that of the bad year of 1889, when the average rate per kantar was practically identical, we find:—

Value of crop in 1889 = £E. 8576000.

„ „ in 1900 = „ 14723500.

Representing a gain to Egypt, in 1900, of £E.6147500 over 1889.

\* Up to the 12th of July, the actual figures given by the Alexandria General Produce Association are 5,421,428 kantars. Reliable information is, however, to hand, that some 200,000 kantars are still to be brought in, so it seems probable that the figure of 5½ millions will be exceeded.

*The Sugar-cane Crop.*

The results of the year were satisfactory, as the following table shows:—

	SEASON 1896-1897.			SEASON 1897-1898.			SEASON 1898-1899.			SEASON 1899-1900.			SEASON 1900-1901.		
	Cane crushed.	Out-turn No. 1 sugar.	Percentage.	Cane crushed.	Out-turn No. 1 sugar.	Percentage.	Cane crushed.	Out-turn No. 1 sugar.	Percentage.	Cane crushed.	Out-turn No. 1 sugar.	Percentage.	Cane crushed.	Out-turn No. 1 sugar.	Percentage.
Payments	Kantars.	Kantars.		Kantars.	Kantars.		Kantars.	Kantars.		Kantars.	Kantars.		Kantars.	Kantars.	
Daira Saïdch.	15,815,112	1,590,352	10.1	11,178,316	1,230,373	8.5	13,680,911	1,253,525	9.2	11,515,568	1,369,953	9.4	11,850,185	1,161,171	9.8
Daira Sultan Pasha.	587,167	53,589	9.1	151,390	36,510	8.1	179,822	43,885	9.1	166,927	42,059	9.2	521,166	49,169	9.4
Société Générale des Sucreries de la Haute-Egypte	3,799,962	39,551	10.4	5,098,896	101,131	8.0	6,250,320	601,002	9.6	5,978,871	375,103	9.6	6,908,772	682,587	9.88
Egyptian Sugar & Land Company.	—	—	—	—	—	—	516,355	49,338	9.3	501,336	16,608	9.2	850,500	81,810	9.6
Beni-Korrah.	110,000	31,000	8.3	270,000	18,000	6.7	—	—	—	501,337	16,608	9.2	—	—	—
TOTALS.	20,612,511	2,073,192	10.1	20,298,632	1,680,317	8.3	20,957,111	1,950,750	9.3	21,969,136	2,080,637	9.4	20,131,223	1,975,337	9.8

The area planted with cane was, again, rather less than the average. This was partly due to the increase in cotton cultivation.

The “Société Générale des Sucreries,” instituted an important experiment, in the year 1900, in the shape of cultivation of Beetroot.\* The results, so far, appear to have been satisfactory, but the cultivation of this crop, in Egypt, is still only in an experimental stage, and the cultivators lack experience in raising it. Should it prove a success, a very important addition will have been made to the agricultural products of the country.

#### *“Kedi,” or Summer Dhurra.*

The area, under this crop, is still increasing in Upper Egypt. 96,549 feddans were planted in 1900, as against 87,766 feddans in the previous year. This is equivalent to an increase of 10% in 1900, over 1899. This last year, again, was 8% in excess of 1898. This increase is chiefly in the Girga Province. As was stated in last year's report, the Kedi Dhurra is a most profitable crop to the producer, but its introduction, upon a large scale, not infrequently delays the opening of the basins, in which it is grown, at the proper time. Consequently, these areas lose a portion of the benefits of the fertilizing silt which is carried in suspension in the water of the early flood.

#### *The Maize Crop.*

In spite of the delay in the sowings in Lower Egypt, this crop, in 1900, was a good one and fully up to the average.

#### *The Rice Crop.*

For the reasons already given, very little rice was planted in 1900.

#### *Winter Crops.*

These were good, both in Upper and in Lower Egypt.

### DUTY OF WATER.

There are few questions more important to the Irrigation Officer than a knowledge of the “duty” of the water which he has to distribute.

\* In the figures given for their factory, for 1900, some 334,000 kantars are Beetroot.



I am glad to know that this is now receiving far more attention than was formerly the case.

Major Brown, in his report, discusses the question at considerable length, arriving at the conclusion that, for sefi crops, other than rice, an allowance of from 21 to 22 metres cube per feddan is sufficient.\* The mean discharge allowed, therefore, at the head of the canal, should be calculated at the rate of 22 cubic metres per feddan of sefi crop, other than rice. Our practice, hitherto, has been to allow a rate of 24 cubic metres per feddan of crop, but as Major Brown points out, we have, hitherto, assumed that only one-third of the cultivable area was under summer crop, at one time, whereas two-fifths of this area are now habitually planted.

For rice, 40 cubic metres per feddan have been allowed in all calculations, but, as Major Brown rightly says, this crop will take as much water as it can get, and, moreover, requires irrigation at very short intervals. It is evident, that such a crop upon a large scale, makes any perfect system of rotations very difficult. Major Brown, in consequence, is anxious to see the cultivation of "Saltani," or summer rice, limited to the poorer and salted lands, and that of "Sabaini," or flood rice, substituted for it. Such a change may be very desirable from the point of view of water distribution, but would be very difficult to introduce generally. It could only be done by so arranging the rotations programmes as to disregard summer rice cultivation, except in the bad lands. I do not think such a measure would be advisable. "Sultani" rice cultivation washes the lands more effectually than any other system, and large areas exist which, if deprived of this remedy, for several successive years, would degenerate into "Sebakh," or salted lands. Moreover, the owners ought to understand what is best suited to their lands and if they prefer to cultivate "Sultani" to "Sabaini" rice, they cannot be prevented from doing so, whenever water is available. In a year like 1900, it was of course impossible to save the rice, except at the expense of the cotton crop. In former years of ordinary supply, however, both a large cotton, and a large rice crop have been gathered, and I see no reason why this should not, under similar conditions, be equally possible in the future, as in the past.

The following are the tables of "Duty of water" worked out by Mr. Verschoyle and Major Brown, for Upper, and for Lower Egypt, respectively.

\* Allowing that one watering in 21 days, is what is best suited for the cotton crop.

UPPER EGYPT.

PROVINCES.	Duty of water. — Metres cube per feddan.
Assiout, Minieh, Beni-Suef and Fayoum (together) ...	26·60
Minieh and Beni-Suef (together) ... .. .	24·40
Beni-Suef (alone) ... .. .	22·30
Fayoum (alone)... .. .	31·80

These duties are Considerably lower than those for 1899. In that year, the supply was a moderate one and the water had to be economically distributed. In 1900, thanks to the raising of the water-level of the river at Assiout, the supply was better, and the crop area being much the same as in the previous year, the duty per metre cube, per feddan, is consequently lower.

In Lower Egypt, the contrast is very remarkable. Major Brown gives two tables, one, assuming one-third of the taxed area to be under crop, and the other assuming two-fifths of this area to be cultivated.

The taxed area affords the only means we have of ascertaining the superficies actually planted. It has, therefore, been used as a basis for calculation.

PROVINCES.	Duty of water. — One-third taxed area.	Two-fifths taxed area.
Kaliubia, Sharkia and Dakahlia ... .. .	23·77	19·81
Menufiyeh and Gharbieh ... .. .	21·26	17·72
Behera ... .. .	23·72	19·77
For the whole of Lower Egypt ... .. .	22 71	18·09

These figures show that in Gharbieh and Menufiyeh, *i.e.* in the 2nd Circle of Irrigation, each metre cube of water does more useful work than in either of the other two Circles.

I would refer anyone desiring fuller information upon this question to Major Brown's very interesting notes upon the subject.

*River Gauges in the Soudan.*

These are gradually being extended. Regular information is now furnished from Rosaires, Sennar and Wad Medani on the Blue Nile. A new gauge has been erected at Berber, below the Atbara junction. As regards the White Nile, the information for 1900, was very scanty.

A gauge is read daily at Nasser, on the Sobat, but the register, owing to the impossibility of navigating this river in the summer, takes months to reach Cairo. The Fashoda gauge was unfortunately moved from its place, in 1900, so the record is useless for purposes of comparison. During my visit to the Upper Nile, in the spring of 1901, permanent gauges were erected at Gondokoro, on the Bahr-el-Gebel, and at Taufikia and El Duem on the White Nile. It is to be hoped, then, that ere long we shall have equally good information regarding this river, as we have for the Blue Nile.

*The Victoria Nyanza Lake Gauges.*

Lord Cromer, in his Report upon the administration of Egypt in 1900,\* has quoted my remarks upon the above, at some length. I will not, then, repeat them here, beyond mentioning that these gauges show a steady fall, from the 1st of October, 1898, to the same date in 1900. At Port-Victoria (Ugowé) the fall in these two years was 2 feet 1½ inches and at Port-Alice (Entebbé) 1 foot 7 inches. This fall would appear to establish a connection between a low Lake-level and a low summer supply in Egypt, during the following year. In June, 1901, information has been received, to the effect, that the Lake-level has risen 3 feet 3 inches in the space of six months. The effect of this rise upon the Nile flood of 1901 remains to be seen. It is to be hoped that it may mean a good summer supply in the White Nile in 1902.

A gauge upon the Lake Albert Nyanza is urgently required. The information afforded by a register of the levels of this sheet of water would be invaluable to Egypt.

*Irrigation Expenditure in 1900.*

The following tables give particulars of the expenditure upon Irrigation works in 1900. The total sums disbursed, amounted to £E.1173612.884 mill. This does not include the sums paid to Sir John Aird & Co., for the Nile Reservoir Works.

The expenditure is distributed as follows:—

TABLE I.  
ORDINARY BUDGET.

	£E.	Mill.
Central Office charges (including supplementary		
Reservoir Works),... ..	80919	954
Upper Egypt ... ..	224667	461
Lower Egypt ... ..	356644	007
Total ... ..	<u>£E.662231</u>	<u>422</u>

\* Foreign Office *Blue Book*, Egypt No. 1 (1901).

TABLE II.

EXTRAORDINARY BUDGET.

	£E.	Mill.
Drainage Works (Caisse) ... ..	168226	542
Irrigation Works (Caisse) ... ..	118796	941
New weirs below Barrage (Caisse) ... ..	182260	305
Total ... ..	<u>£E.469282</u>	<u>888</u>

TABLE III.

VARIOUS SPECIAL CREDITS.

	£E.	Mill.
Low Nile Credit (Caisse) ... ..	12985	000
Mahmudiyeh canal dredging (Caisse) ... ..	3882	182
Rosetta and Damietta Sadds (Caisse) ... ..	14343	926
Barrage Gardens (Revenue of Gardens) ... ..	887	466
Removal of sudd in the Bahr el Gebel (Finance Ministry) ... ..	10000	000
Total ... ..	<u>£E.42098</u>	<u>574</u>

TABLE IV.

TOTAL EXPENDITURE.

	£E.	Mill.
Ordinary Budget ... ..	662231	422
Extraordinary Budget ... ..	469282	888
Various Special Credits ... ..	42098	574
Total ... ..	<u>£E.1173612</u>	<u>884</u>

The expenditure under "Ordinary Budget," as above, may be again distributed, as follows:—

TABLE V.

	£E.	Mill.
Regular Budget (including supplementary Reservoir Works) ... ..	214482	989
Corvée Relief (granted by the Caisse) ... ..	249998	943
Corvée Relief (granted by the Finance Ministry) ...	150294	692
Agricultural Roads ... ..	39564	994
Special credits for Bridges to replace Ferries ... ..	7889	804
Total ... ..	<u>£E.662231</u>	<u>422</u>

The item "Regular Budget" again, in above table, is thus subdivided:—

TABLE VI.

	£E.	Mill.
Establishment ... ..	72849	018
Contingent charges ... ..	21438	099
New Works ... ..	18413	215
Maintenance and Repairs ... ..	69805	797
Kharatbeh and Atfeh Pumps ... ..	494	743
Drainage of Lake Marcoris ... ..	7734	970
Land charges ... ..	2383	123
Supplementary works connected with Reservoir ...	21334	024
Total ... ..	<u>£E.214482</u>	<u>989</u>

I will very briefly discuss each of these items.

*Establishment and Contingent Charges.*

These two items are in excess of the charges for 1899, by £E.4346,139 mill., but they call for no special remark. The establishment charges are slowly increasing with the large increase in the yearly expenditure.

*New Works.*

The expenditure, under this head, is less, by £E.7767,472 mill., than that of 1899. The reason is, as was explained in last year's Report, that an arrangement has been made with the Caisse de la Dette, whereby the Public Works Department finds an annual sum from its own Budget for certain works, on consideration of the Caisse granting a special credit for the same. There is no real reduction, thus, upon new works. The money, instead of being allotted to the Budgets of different Irrigation Circles, is placed in the General Reserve, and from this is distributed between the credits for Special Works.

*Maintenance and Repairs.*

This item of expenditure is also less, for 1900, than for 1899, by £E.12442,269 mill. The reason is the same as that given above for new works.

• *Khatatbeh and Atfeh Pumps.*

These charges are less in 1900, than they were in the year previous, by £E.96,536 mill.

*Drainage of Lake Marcotis.*

The Budget expenditure upon pumping was less in 1900, by £E.1240,030 mill., than it was in 1899.

*Land Charges.*

These show an excess of £E.743,435 mill., over the expenditure for 1899.

*Supplementary Works connected with the Reservoir.*

These are for charges, not included in the contract made with Sir John Aird & Co. The principal item is the cost of the supervising

Government Staff at Assuan and Assiut, but there is a heavy charge for dredging in the river, at the latter place, necessitated by the blocking of the channel by sandbanks.

*Corvée Relief.*

Referring to Table V: the next item, for remark, is that of Corvée Relief.

This expenditure may be subdivided as follows:—

TABLE VII.

	Upper Egypt.		Lower Egypt.		Total.	
	£E.	Mill.	£E.	Mill.	£E.	Mill.
Money furnished by the Caisse ...	128000	000	121998	943	249998	943
Money found from Regular Budget	34949	998	115344	694	150294	692
Total ... ..	162949	998	237343	637	400293	635

The distribution of these credits, as regards the Caisse money, between the different Provinces was the same as in previous years. That of the money found from the Budget, differed, as it must always do, according to the importance of the Relief works in the several localities.

The only two items of expenditure in Table V, remaining for discussion are, that for Bridges to replace Ferries, and that for Agricultural Roads.

*Bridges to replace Ferries.*

The total expenditure in 1900, was £E.7889,804 mill. For this sum, twelve bridges were put in hand, three being in Upper, and nine in Lower Egypt. They are all well advanced towards completion. These bridges are of great service to the village population.

*Agricultural Roads.*

The following are the figures for 1900:—

LOCALITY.	Length of roads existing previous to 1900.	Length of road constructed in 1900	Expenditure in 1900.	
	Kilometres.	Kilometres.	£E.	Mill.
Upper Egypt and the Fayoum ... ..	518	98	7996	662
Lower Egypt... ..	1518	247	31568	332
Total... ..	2036	345	39564	994

The maintenance charges were as follows :

												£E.
Upper Egypt	...	...	...	...	...	...	...	...	...	...	...	3079
Lower Egypt	...	...	...	...	...	...	...	...	...	...	...	2522
Total...												£E.5601

At the end of 1900, the total length of existing roads in Egypt was 2381 kilometres.

Major Brown, in his Report, again draws attention to the yearly increasing difficulty of providing for the maintenance of these roads. The rates, per kilometre of maintenance, vary considerably in Upper and in Lower Egypt.

Taking into account the total length of road in each area, it was :—

For the former, in 1900	...	...	...	...	...	£E.5.94	per kilometre.
For the latter, in 1900	...	...	...	...	...	„ 1.66	„

That for Upper Egypt is very high, and that for Lower Egypt is, apparently, far too low. The explanation is, that only a portion of the total length of roads in Lower Egypt, was repaired. Mr. Verschoyle estimates the annual cost at £E.3.7 per kilometre. At the present moment there are 2381 kilometres of existing road. Adopting Mr. Verschoyle's rate, which probably is the lowest figure possible, the total annual sum required to keep these roads in order amounts to £E.9110. It must be remembered that the length of roads is being yearly added to, so that the above will not represent the sum required, in a few years' time. Simultaneously with road extension, the lengths of new canals and drains are being largely augmented, and each of these channels requires an annual expenditure upon clearance and upon general maintenance. It is impossible to materially reduce these charges. Consequently, the roads have to suffer. In his report for last year, Major Brown advocated that a special road-tax should be levied upon the cultivated area profiting by these highways. The Provincial Councils, to whom this proposal was submitted, unanimously rejected it. They based their refusal upon the ground that, the first cost of these roads had been paid by them from a special rate, voted by themselves, upon the land, and that the Government had contributed nothing towards the expense of their construction. They, therefore, considered that they should not be called upon to bear any further charges for works which, they maintained, might be fairly considered as of public utility.

Without examining into the logic of these arguments, the fact remains, that the local Councils have refused to pay for the mainten-

ance of these roads. Unless they are annually repaired, they speedily become useless. The necessary funds cannot be found from the Public Works Budget, except at the expense of the drains and canals, and this is inadmissible. The circle is then a vicious one, and the only way out of the difficulty, unless a special extra annual credit can be granted, appears to be the suspension of all future road extensions, until such time as the present expenditure upon Special Irrigation Works can be reduced. This stoppage would be regrettable, as the roads are of great service to the agricultural population. At the same time, there seems to be no other possible solution.

#### EXTRAORDINARY BUDGET.

I will now turn to Tables II and III, viz., works constructed under, what is known as, the Extraordinary Budget, and from various special credits. I will discuss them in the order in which they come, in the above tables. I should say that, in such items as Drainage and Irrigation Works, expenditure has been incurred under the Ordinary, as well as the Extraordinary Budget. I shall not in the following remarks attempt to separate the expenditure from these different sources, but will merely discuss the work done, in each instance, as a whole.

#### DRAINAGE WORKS IN 1900.

The total expenditure for the year was :

	£E.	Mill.
In Upper Egypt ... ..	7183	180
In Lower Egypt ... ..	167443	000
Total... ..	£E.174626	180

A balance of £E.26783,272 was unspent at the end of the year. This sum, as was the case in the previous year, is chiefly due for land taken up for the new drains, the accounts for which had not been presented by the Mudirieh officials in sufficient time to permit of payments being made in 1900.

For the above sum, 185½ kilometres of new drain, were dug, and 110½ kilometres of existing drains, enlarged and remodelled. This expenditure includes the construction of all the necessary masonry and timber structures, in connection with these channels. It also includes a cube of earthwork, amounting to nearly five million metres.

The principal drainage systems remodelled, in 1900, were the following :—



*Upper Egypt.*

In the Fayoum Province—

A commencement was made with the Tagin system.

*Lower Egypt.*

In the Sharkiyeh and Dakahliyah Provinces—

The Bahr-el-Bagar, Arin, Nizam, Saft and Seru systems.

In the Gharbiyah Province—

The Shibin, Sharkawiyeh, Bahr-Mallah and Nashart systems.

In the Behera Province—

The Edku and Mareotis systems.

Such progress has been made, of late years, with drainage works, especially in Lower Egypt, that it is possible to look forward to a time when the system shall be practically completed. Between the years 1885 and 1900 (inclusive), a total sum of £E.1285412, has been expended upon drainage works in Upper and in Lower Egypt. For the above expenditure, 3145 kilometres of new drains have been constructed, and 555 kilometres of old, badly aligned, drains, enlarged and remodelled. The area benefitted by these drains is not much less than 3,000,000 feddans. A very few years more, at the present rate of progress, should see all the main systems completed in Lower Egypt. There will doubtless be minor projects to be taken in hand, but these will not involve any heavy annual expenditure.

In Upper Egypt, there will be, for some years, a great deal of work to be done. The conversion of huge tracts of basin land, to perennially irrigated areas, will necessitate a considerable expenditure upon drainage. Large pumping stations are to be erected upon the Nile, for the purpose of getting rid of the drainage water when the river is in flood, and a considerable enlargement of the existing system will be necessitated. In the Fayoum Province, also, there will be much work to do for several years to come.

*Pumping Stations for Drainage in Lower Egypt.*

Two stations exist for this purpose; at Kassassin, in the Sharkiyeh Province, and at Mex, in the Behera Province.

The former is for the purpose of draining the Wadi-Tumilat, and will be alluded to later on. The expenditure in pumping, for 1900, was £E.3230. The latter is a very important pumping station, and

upon it a large portion of the drainage system of Behera depends. The western drains of this Province all tail into lake Mareotis, and the water of this lake is lifted by the pumps and discharged into the sea, at Mex. The installation consists of five "Farcot" direct acting centrifugal pumps and two 48-inch "Gwynnes" centrifugal pumps. These pumps, when all at work, are capable of lifting three millions of cubic metres of water in 24 hours. In the winter of 1899-1900, they worked from the 4th of November 1899 to the 4th of April 1900. They lifted, in this period, a total of 202,987,741 metres cube of water. This amount was less than that of the previous year, owing to the low flood levels of 1899 and the light rainfall of the following winter.

The total expenditure was £E.9391, which was higher than the average of previous years, owing to the rise in the price of coal. The rate per million cubic metres of water lifted, was £E.46.261, which is the highest rate yet reached.

If the expenditure at Mex and Kassassin Pumping Stations be added to that for other drainage works, the total sum expended, under this head, in 1900, amounts to £E. 487247,180.

As an example of the effect of the new drainage works I may repeat here, the facts which I gave in my report for 1898. The figures are all derived from the Ministry of Finance. In 139 villages, served by the new drains, new taxes upon reclaimed land were collected to the value of £E.8639. The arrears of taxation in these villages that, in 1895, (previous to the construction of the drains) amounted to £E.12080, were reduced, in 1898, to £E.2684. Lastly, the seizures, in default of payment, were reduced from £E.17771, in 1896, to £E.6372, in 1898. The drains in question had only been working for two years. These figures only represent the benefits realised in one, comparatively small, locality, but the same results are taking place all over the country, wherever the new drains have been completed.

#### *Main Irrigation Improvements, in 1900.*

The expenditure, for 1900 was:—

	£E.
In Upper Egypt. ... ..	143750
In Lower Egypt. ... ..	41748
Total... ..	<hr/> 185498

The following remarks briefly describe the principal works undertaken during the year.

## IN UPPER EGYPT.

### (1) *The remodelling of the Basins, west of the Yusfi.*

This project has been described in my last year's Report. It is estimated to cost £E.200000. It is now approaching completion, £E.156939 having been expended up to the end of 1900, and of which £E.84126 was spent last year.

### (2) *The Mazarah Regulator and Lock in the Bahr Yusfi.*

The objects of this work are threefold, viz., to improve the irrigation of 77,000 feddans of land; to afford a means of draining a portion of the Sefi area of Minieh Province, by discharging it into the canal downstream of the regulator; and lastly, to supplement the flood supply of future perennial canals, required for the conversion of the basins of Beni-Suef Province. This work has been pushed on with great energy by Mr. Clowes and his assistant Mr. Sachs. The foundations and floor were completed before the flood. £E.23868 were spent in 1900, out of a total estimate of £E.45000.

### (3) *Remodelling works in the Fayum Province.*

A commencement only, was made in 1900. The total estimate amounts to £E.126000, but the different projects will take two, or more, years to complete. The improvement of the Bahr-Nazleh and its branches was commenced, and good progress was made with this channel, including the masonry works.

### (4) *The preparation of the projects for the conversion of the Middle Egypt basins to perennial irrigation, in connection with the Nile Reservoir.*

This work, which is under the very able direction of Ismail Bey Sirri, was vigorously prosecuted in 1900; so much so, that a good start with the works will be made in 1901. The project for the Province of Assiout is completed and the estimate amounts to £E.110000. The project for Minieh Province is in an advanced state of progress. In addition to the actual works necessitated by the conversion of the basins, the Ibrahimiyeh canal will require to be widened for a great portion of its length. This work will be spread over several years. It is proposed to spend £E.30000 upon it in 1901. The total expenditure upon the preparation of these projects, in 1900, was £E.3500.

## LOWER EGYPT.

In the northern Provinces, the expenditure upon Irrigation improvements was comparatively small, the available credits for new works having been principally devoted to drainage.

A new head was built to the Saidieh canal at a cost of £E.1788. Materials were collected for the new regulator and lock required for the Ismailia canal at a cost of £E.2160.

In the Behera Province, the widening of the Sahel-Markaz canal (described in previous Reports) was proceeded with. £E.7254 was spent in 1900.

In the Ghizeh Province, a considerable amount of remodelling work was executed in 1900, and a total of £E.25517 was expended in that year. These works are for the purpose of ensuring that the early flood water shall enter the basins of this province and that a good supply, at a high level, shall be given to the high lands bordering the river, as far north as the Barrage.

£E.5029 was spent in 1900, upon collection of materials for the new head for the Rayyah Behera, at the Barrage.

## THE BARRAGE.

The special repairs being completed, nothing was spent upon this structure beyond the ordinary maintenance charges for up-keep and staff.

The following is the detail:—

	£E.
Staff... ..	4607
River training ... ..	2932
Maintenance ... ..	6737
Special repairs ... ..	2085
Gardens ... ..	1622
Sundries ... ..	145
Total... ..	<u>£E.18129</u>

None of these items call for any very special remark. The river training is being carried on from year to year, and the special repairs were limited to the parapets and roadway of the structure.

I have already alluded to the work done by the Barrage in 1900. Thanks to the new weirs, the water was maintained upstream of this work, in July, at a higher level than had ever previously been possible. Throughout the low flood also, the Barrage, by regulation, rendered

excellent service to Lower Egypt. It is not too much to say, that the Barrage, with the new weirs, saved the cotton crop of Lower Egypt last year, and played a material part in securing the maize crop as well.

#### THE NEW WEIRS DOWNSTREAM OF THE BARRAGE.

The object and nature of these weirs has been fully described in my previous Reports. Major Brown, in his Report, gives a most interesting and detailed account of the work done in 1900, so my remarks upon it will be extremely brief. The programme laid down for last year was a very heavy one, viz., the entire construction of the weir across the Rosetta Branch of the river, to one metre below crest level, and at the same time the completion of the lock in the Damietta Branch and the raising of the weir in that channel also. Work was commenced on the 1st November, 1899, and by the 30th of July, 1900, the programme had been more than fully carried out. The Rosetta weir, 500 metres long, was carried right across the river bed to the height anticipated. The lock was finished and the gates hung. The Damietta weir was raised and the lock in that branch completed. Lastly, 122 upper gates, each  $1\frac{1}{2}$  metres high, were added to those existing on the Barrage itself. 94,789 barrels of Portland cement were used in 1900, and the quantities of materials used (vide Major Brown's Report) give an idea of the amount of work done. The total expenditure upon these weirs, to the end of 1900, has been £E.423992, of which, £E.182263 was spent last year.

I think the above performance may be fairly classed as a record one. The greatest credit must be given to the whole of the staff employed, but to Major Brown himself, a still larger measure of praise must be allotted. It is entirely due to his ceaseless superintendence and untiring energy, that, what appeared to be almost an impossible task, was successfully accomplished, and, moreover, in time to permit of these weirs playing a most important part in connection with the preservation of the crops.

When, early in 1897,\* I came to the conclusion that, in order to complete the work of Sir Colin Scott Moncrieff, on the Barrage, it was desirable to construct subsidiary weirs in each branch of the river, I scarcely anticipated that, within little more than three years from the time of writing, the works which I then advocated, "should funds ever be available," would be completed, and would, in the very first

\* Vide Report upon the work of the Irrigation Branch for 1895.

year of their existence, enable us to save the cotton crop, by raising the water-level up-stream of the Barrage in the month of July. That this result has been possible, is entirely due to Major Brown's hard work.

#### WORKS CARRIED OUT FROM VARIOUS SPECIAL CREDITS.

Reference to Table III. of this Report, will show the works included under this head. I will discuss them in the order in which they are entered in the table in question.

#### *Special low Nile Expenditure.*

The total amount expended under this head may be divided into three categories, viz.:—

	£E.	Mill.
(1) Expenditure in Upper and Lower Egypt, entailed by the low summer supply and low flood ... ..	12985	000
(2) Earthen dams in the Damietta and Rosetta Branches ... ..	14343	926
(3) Dredging the Mahmudiyeh Canal ... ..	3882	183
Total... ..	£E.31211	109

No. (1). As regards Upper Egypt, the expenditure was that entailed by the measures for the prevention of "Sharaki," such as temporary banks formed round the higher spots, in order to ensure their irrigation. In Lower Egypt, it includes, the temporary staff employed upon the rotations; also pumping charges and special measures for the irrigation of the higher lands.

No. (2). The sudd, near Damietta, cost £E.4936, and that in the Rosetta Branch, £E.9408. Neither dam was closed quite early enough, and, in each case, a certain amount of salt water found its way into the river channel above. In the case of the Damietta sudd, the amount was so small that a flush sent down the river, from the canals at Mit Ghamr, remedied the evil. In the case of the Rosetta Branch, matters were more serious. The was closed on the 13th of April, but the salt water extended as far south as Atfeh, where the pumps which supply the Mahmudiyeh are erected. It was not until the 15th of May that the water became sweet enough to permit of these pumps working.

No. (3). *The Mahmudieh Canal Dredging.*—This was a special work, undertaken with a view to improve the water-supply of Alexandria. The canal, in the reach in which the intake of the pumps is situated, had become silted up to such an extent that the water was much fouled. The dredging appears to have somewhat

improved matters, but, until the drinking water for this town is drawn from the canal, at a considerable distance further upstream, there can be no real improvement in its quality.

The other items in Table III are: the Barrage Gardens and the removal of the sudd in the Bahr-el-Gebel. The first calls for no special remark.

The sum of £E.887-466, merely represents the Revenue resulting from the sale of fruit, etc.; the amount being applied to the improvement of these gardens.

#### THE REMOVAL OF THE BAHR EL GEBEL SUDDS.

As I have written a special report upon the above, I will only say here, that Major Peake and his party successfully removed 14 blocks of Sudd, in the northern reaches of this river, between the months of January and March, 1900. The total expenditure incurred during the year was £E.10000.

#### WORKS NOT ALREADY MENTIONED, EXECUTED UNDER THE ALLOTMENTS OF THE ORDINARY BUDGET.

These include Masonry works, new and repaired; Earthwork, including dredging of canals; River protection and Basin Bank protection. I will take them in the above order.

#### *Masonry Works, New and Repaired.*

The following is the detail of the expenditure, which does not include any works undertaken under the special credits:—

LOCALITY.	New Works.	Alterations & Repairs to existing works.	Totals.
	£E.	£E.	£E.
Upper Egypt ... ..	3552	15513	19065
Lower Egypt ... ..	2494	16496	18990
Totals ... ..	6046	32009	38055

All these works were comparatively unimportant, with the following two exceptions. The Sohagiyeh Syphon, which blew up in 1899, was

rebuilt at a cost of £E.5584. New grooves were placed in the Ibrahimiyeħ Canal head at Deirut, at a cost of £E.3106.

The repairs estimates for Upper Egypt for 1901, will unfortunately show a larger figure than the above, as two accidents occurred to large masonry works, during the period of Basin irrigation and discharge.

On the 12th of September, the upstream wing-wall of the Qolosna Aqueduct, which carries the Ibrahimieh Canal over the Abu Bagara, gave way.

Again, on the 16th November, the large masonry work known as the Hamad Escape (at the tail of the Ghilasi basin system) collapsed; the railway bridge, immediately upstream, following suit. This accident was due to the negligence, and disobedience to orders, of the official charged with the "Sarf" operations of these basins. He was tried for this offence by a Council of Discipline, and was dismissed from the Service of the Government.

*Earthwork executed in 1900.*

The following are the dredging totals:—

LOCALITY.	Metres cube dredged.	Cost.
		£E.
Upper Egypt ... ..	268,581	10555
Lower Egypt ... ..	2,120,215	73830
Totals ... ..	2,388,796	84385

The cubes in Upper Egypt are considerably below the normal figures. The dredging in the Ibrahimiyeh canal was less than that of any year (except 1899) since 1891. On the other hand, there was a considerable amount of dredging necessitated in the river at Assiout.

The cube of earthwork executed by hand-labour was as follows:—

LOCALITY.	Metres cube.	Cost.
		£ E.
Upper Egypt ... ..	9,562,561	119552
Lower Egypt ... ..	13,298,892	228162
Totals ... ..	22,861,453	347714

These figures call for no special remark. They closely approximate those of the year previous.



*River and Canal Protective Works.*

The following is the expenditure for 1900:—

										£E.	Mill.
Upper Egypt	...	...	...	...	...	...	...	...	...	6622	524
Lower Egypt	...	...	...	...	...	...	...	...	...	26228	000
Total										£E.32850	524

The expenditure, in Lower Egypt, includes the Spurs on the Rayyah Menufiyeh, and the repairs to the Abukir Sea-Wall.

*Basin Bank Protection.*

3,863 metres of bank were revetted with stone, in 1900, at a cost of £E.2257.

THE NILE CORVEE IN 1900.

The figures for 1900, are not so small as those for 1899; last year's flood, although low, having been higher than was the case in the previous year.

Nevertheless, as both Inspectors General of Irrigation admit, the numbers of watchmen called out, in 1900, ought to have been lower than they actually were. The only explanation is, that last year's flood rose early and rapidly, and at one time promised to be a high one. In other words, higher levels were expected than actually resulted. The information regarding the river from the south, gave little help, inasmuch as no comparison with previous year was possible. The men were consequently called out to watch the banks in the anticipation of a high Nile. A similar mistake is not likely to occur again, as, in future years, it will be possible to compare the Soudan river gauges with those of 1900.

The following figures represent the number of watchmen called out to guard the banks for 100 days:—

Upper Egypt	...	...	...	...	...	11,929
Lower Egypt	...	...	...	...	...	3,510
Total.						15,439 men for a hundred days.

In 1899, the figure was 7,388 men for the same period.

I have used the unit of 100 days, as it affords the only means of comparison with former years. It is perhaps misleading. In reality, except in very exceptional cases, the flood watchmen are never upon

the banks for such a period of time. The average may be taken as from 40 to 45 days, and is very frequently less. No one man, is ever called out to serve for a longer time than 15 days. At the end of that period, he is relieved by another. A roster is kept by the Moudiriye officials, in which the name of every man, on the list for service, is inscribed, and each one is called out in rotation.

The basin banks in Upper Egypt are largely responsible for the high numbers. It is necessary to guard these against the wave action, caused by the winds disturbing the surfaces of these large sheets of water. This task is independent of the height of the river, and the figures vary but little from year to year. In 1900, the long stretch of new banks, on the basins west of the Yusfi, materially added to the high figure. By degrees, these banks are being revetted with stone, but the process is slow, and is a costly one.

The following is a comparison of the men called out in 1900, with those of the four lowest floods of the last 17 years:—

1888 ... ..	58,788	men for 100 days.
1893 ... ..	32,752	" "
1897 ... ..	11,067	" "
1899 ... ..	7,388	" "
1900 ... ..	15,439	" "

The question of abolishing the Nile Corvée, altogether, is receiving, at this moment, our serious study. It is a problem not very easy to solve, as it very difficult to estimate the yearly cost that would be entailed by the substitution of contract labour for the present system. The risks, contingent upon a failure of the Nile bank, are so great, that few contractors would care to take the responsibility of guarding the Nile banks, without a very heavy set-off in the way of money. On the other hand, the forfeiture by a contractor, of a considerable amount of caution-money, would hardly recoup the Government for the damage that would be caused by a breach of the river bank, in flood time. Again, in years of dangerous flood, it would be indispensable to call out the people, as at present, to guard the banks. Upon this point there can be no two opinions, and all are agreed as to this necessity. The hardship actually entailed to the people, by the present system is, in reality, not a very great one. As has been explained, no man is called out for a longer period than 15 days, and at the time of his service, agricultural operations (with the exception of the cotton picking which is mostly done by the women and children) are more or less at a stand-still. The true policy would appear to be; to proceed very slowly in this matter. Year by year, especially with an improved

knowledge of the flood in the south, the number of watchmen can be reduced, and the period for which the men are called out abridged. Improvements, such as the introduction of telephone lines along the river banks, and the massing of repair gangs at certain points (where houses may be constructed for them), will probably tend still further to reduce the small inconvenience, at present, caused to a limited number of the population. Expenditure upon river training, basin bank protection, and a better type of culvert in the Nile banks, will, by degrees, enable us still further to reduce the numbers.

### THE WADI TUMILAT.

In my last year's Report, I gave a short account of the results obtained, in the first year, as regards the reclamation of this tract. I am happy to say that the reports, for last year, are again favourable.

In the estimates presented to Government in 1898, the forecast made showed a probable deficit, amounting to £E.5790. In the two first years, *i.e.*, 1899 and 1900, the actual result shows a surplus of £E.314, at the end of last year.

The total revenue of this area, during 1900, amounted to £E.19957, while the total expenditure, including the payment of £E.8000 to the Ministry of Public Instruction, and the working expenses of the Kasasin pumps, was £E.19643. The expenditure on the last item exceeded the estimate by £E.779, owing to the rise in the price of coal. The area of land actually leased in 1900, was 9.382 feddans, or 382 feddans in excess of the forecast. The pumping station was enlarged, by the erection of a new 20-inch pump, and a compound vertical engine. The masonry alterations to the station were so designed as to provide for a further addition of a 30-inch pump, if necessary, in the future. The cost of this work was £E.2435. The enlargement of the main drains dried the lands so thoroughly, that it may be found possible to reduce the estimated number of branch and field drains. The canal-remodelling consists of the substitution of well aligned channels for the old badly-aligned ones, which crossed the low lands and caused water-logging. A flour-mill has been set up on one of the canal regulators, and promises to be remunerative. The crops, in this tract, last year, were good, in spite of the low Nile levels. The cotton and dhurra crops were up to the average and, even a rice crop was saved.

These satisfactory results are mainly due to the energy of Mr. Langley, the Inspector of the Circle, and to his assistant, Musa Bey Ghalib, who is directly in charge of the Wadi Tumilat.

I would refer anyone, desiring further information upon this interesting experiment in land reclamation, to Major Brown's very full note upon the subject.

### THE NILE RESERVOIRS.

It is with deep regret, that I have to record the death, in 1900, of Mr. W. J. Wilson, who had filled the post of Director General of Reservoirs from the date of the commencement of the works. In any undertaking of such magnitude, difficulties must necessarily arise at first, with regard to the interpretation of the several clauses of the contract, and the manner in which the many different works shall be executed. I am certain that Sir John Aird, and his staff, will agree with me in saying, that the way in which all such difficulties were surmounted, on the Reservoir works, was largely due to Mr. Wilson's tact, and to the spirit of fairness which was a marked feature of his character. His professional attainments were of a very high order, and he had won the respect and liking of all who had the privilege of his acquaintance. His constant kindness and generosity to the junior members of his Department were well-known. A large circle of friends mourns his loss, while the whole Department of Public Works feels a keen sorrow, at the loss of one of its ablest members. It is sad to think that he was not spared to see the completion of the gigantic works which must always be associated with his name; to which he had devoted the last years of his life, and, it is to be feared, sacrificed his health. Of my own personal feelings I will not speak, beyond saying that I knew Mr. Wilson well for more than twenty years, and that it was at my suggestion that he came to Egypt. With his death, I have lost a valued friend and a trusted adviser.

Happily for the Egyptian Government, it possessed a very able substitute, in the person of Mr. A. L. Webb; at the time of Mr. Wilson's death, Inspector General of Irrigation in Upper Egypt. Mr. Webb was appointed Director General of Reservoirs in the latter half of 1900, and it is from his report upon the year's work, that I now quote. It gives me great pleasure to say that Mr. Webb has already fully justified his selection for this very important post.

The low summer levels of the Nile in 1900, were especially favourable to the execution of the works in the river bed at this place. The progress made was remarkable. So good was it, that, unless any unforeseen accident or delay should arise, there appears to be good

reason to hope that the dam will be completed prior to the flood of 1902, or one year in advance of the contract date.

The total length of this dam is 2,000 metres, and by the end of 1900, the foundations had been laid over a length of 1,700 metres. The average height of the masonry, completed over this length, is 4 metres above low water-level. Good progress was made with the undersluices. Out of a total of 180, 130 were under construction in 1900; 20 of them being lined with cast-iron.

At the end of last year, the only foundation remaining to be done, on the actual line of the dam, was that in the extreme western channel of the river. The foundations, and part of the side walls, of two of the locks, were completed in 1900. The foundations in the first lock turned out badly and necessitated much extra excavation of rock.

The total amount of granite masonry, executed during the year, was 164,605 cubic metres. 368,664 metres cube of excavation, of which 50,000 cubic metres were rock, were completed. The feature of the year's work, was the construction of the foundations of the dam, across the three deep channels, known as the Bab-el-Kebir, the Bab-el-Soghair, and the Bab-el-Harun. In my last year's Report, I described the progress made with the stone "Sudds," or dams, closing these channels, to permit of their being laid dry by pumping. In October 1899, a programme was drawn up for the following year, which allowed for the completion of the foundations in three channels alone.

The rapid fall in the river levels, induced an extension of this programme, and it was decided to make an attempt to get in the foundations in the wide central channel of the Nile as well, leaving only the western channel to be attacked in 1901. The earthen, and sand-bag, dams were therefore continued across this channel, and by February 20th, the river water was completely shut off. The attempt was crowned with the most signal success. Unfortunately, the rock, beneath the surface of the cataract, proved almost everywhere, when laid bare, to be of very inferior quality to what had been anticipated, or estimated for. In the Bab-el-Kebir, the excavation had to be carried down to a depth of eleven and a half metres (some 38 feet) below that shown in the contract drawings. In the Bab-el-Soghair the extra depth of excavation was four metres, or some 33 feet. In the central channel,—bad rock was found in many places, and the average level of the foundation was some two metres deeper than had been anticipated. On, what is known as, the Mohamed Ali island, the extra depth down to the sound rock was four metres. This, not only, increased the cost of the work, but also largely added to the amount of work to be

done.\* That this large programme should have been carried out before the rise of the river, and at a time of year when the temperature is at its highest, is a very remarkable feat. Mr. Fitzmaurice, the Resident Engineer at Assuan, has good reason to congratulate himself upon such results of his summer's work. The success attained is due to his efforts.

On the 12th of July, the sudd was cut in the central channel, and by the first week in August, the Nile rose over the masonry, and work was suspended. After the flood had passed, masonry was again started and preparations made for damming the west channel. The total payments made to the contractor on the Assuan dam up to the end of 1900, has been £1,407,129. Of this amount £743,343 was paid in 1900. A portion of these sums were advances upon plant and materials, to be recovered during the progress of the work. The actual value of the permanent work, done up to the end of the year 1900, is £E.937,620. The average number of men employed on the works was 5,134, of whom 987 were Europeans. The maximum number reached was in the month of June when the total was 9,308.

#### THE ASSYUT WEIR.

Although lacking the colossal proportions of the dam at Aswan, the weir across the Nile, at Assyut, is still a work of very great importance. The construction of the foundations of this weir, built, as it is, upon a river bed, which is constantly shifting, and through which countless powerful springs force their way, is a work of very considerable difficulty and one which calls forth all the resources of engineering skill and experience. Mr. Stephens, the Resident Engineer, has signally succeeded in overcoming these difficulties.

By the Flood Season of 1899, as has been described in last year's Report, the floor of, about one quarter of the length of the Barrage, had been laid, and the lock walls and piers had been brought to a height, just above summer water-level. By the end of 1900, 75% of the total work had been completed; 49% of it having been executed in that year. Masonry was recommenced at the end of December, 1899, and by the third week of July, when the rising flood stopped further work, the foundations of the Barrage had been carried right across the

\* A detailed list, showing the quantities of work done will be found in Mr. Webb's report for 1900.

river, with the exception of a short length of 20 metres, and a further length of 140 metres, only partially built. There is little doubt that the foundations would have been completed last year, had it not been for a breach in the eastern dam, surrounding the work, which occurred on the 23rd of July, or five days before the date fixed for the termination of the season work.

The following list shows how great was the progress made in 1900:—

Earthwork in dams ... ..	233,100 metres cube.
Sandbags used in dams ... ..	1,462,000 No.
Excavation and filling... ..	421,870 metres cube.
Dredging ... ..	92,000 " "
Cast-iron piling ... ..	1,241 lineal metres.
Concrete and masonry in floor... ..	46,126 metres cube.
Masonry above floor-level... ..	26,320 " "
Pitching and clay puddling ... ..	52,182 " "

Seventeen 12-inch pumps, with several smaller ones, were kept constantly at work during the time of high pressure. The lock, with the exception of the gates and bridge, is now practically completed. 27 piers are up to full height: 43 others are three-quarters of full height, and 19 others are above summer water-level. Only 21 are as yet untouched. The total payments made by the Government to the contractors, for the Assyut work, up to the end of the year 1900, has been £653,056, of which £237,361 were paid last year. The work is now so far advanced, that it appears absolutely certain, that it, as well as the Ibrahimiyeh canal head-regulator and lock, which form a part of the contract, will be completed early in the year 1902. The number of workmen employed on the Assyut works averaged from 7,000 to 8,000, up to the end of April. In May and June, the numbers were well over 12,000 men, of whom some 370 were Europeans.

The total expenditure at Aswan and Assyut together, up to the 31st December, 1900, is £2,060,185. From this amount, the large advances made for materials, plant, etc., etc., have to be worked off.

The work done by the staff, at both sites, was remarkable. Anyone who has visited Aswan, or Assyut, during the summer months, will appreciate it to the full. The heat at both places is intense, by night as well as by day, and at Aswan, the radiation off the rocks largely increases the discomfort. I have very briefly alluded to the services of Messrs. Fitzmaurice and Stephens, the Resident Engineers at Aswan and Assyut, respectively. It is impossible to praise their work too highly. The best proof of their ability, and of their unsparing energy, lies in the results which they have obtained during the last season, and in the very high-class work that has been turned out at both places.

To Mr. John Blue, and to Mr. McClure, Sir John Aird's representatives at Aswan and at Assyut, the thanks of Government are due for the manner in which they have pushed on the works. They have endeavoured to meet the wishes of the Government, in every possible way. Sir Benjamin Baker, K.C.M.G., who is consulting Engineer to the Egyptian Government for these works, has not only personally inspected them yearly, but has continued, throughout their progress, to advise and assist us upon every single question raised.

#### THE IRRIGATION STAFF IN 1900.

I have on various occasions, in the foregoing pages, alluded to the services rendered by Major Brown, Mr. Webb, Mr. Verschoyle, and the different Inspectors of Irrigation. The results of the year 1900 speak for these Officers far more eloquently than any words of mine can do. In addition to those named, the junior officers of the Department, upon whom fell a large share of extra work and exposure, responded most loyally to the calls made upon them, and have well earned the thanks of the Egyptian Government.

In consequence of Mr. Wilson's death, several changes were necessitated in the Irrigation Service. Upon Mr. Webb's appointment as Director General of Reservoirs, Mr. Verschoyle succeeded him as Inspector General of Irrigation in Upper Egypt. Mr. Verschoyle's place, in the 2nd Circle of Irrigation, was taken by Mr. Dupuis. He again, was succeeded by Mr. Williams, an officer from the Indian Irrigation Service.

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## Part II.—WORKS OTHER THAN IRRIGATION.

### I.—THE TOWN AND BUILDINGS SERVICE.

This Branch of the Public Works Administration, under the very competent direction of Mr. Perry, can show a good record of work for the year 1900. On pages 4 and 5 of this Report, (Tables I, II, III and IV,) the sum expended, as a whole, is given. The following subdivision explains it in further detail. The total expenditure for the year was distributed under the following heads :—

	£E.	Mill.
(a) Ordinary Budget ... ..	221398	956
(b) Special credits granted by the Caisse de la Dette ...	152070	000
(c) Special funds provided by other Departments ...	12154	074
(d) Special works executed from Revenue ... ..	6759	616
Total expenditure... ..	£E.392382	646

The details of the above are as follows :—

#### (a) ORDINARY BUDGET.

	£E.	Mill.
(1) General Direction ... ..	22008	904
(2) Public Buildings ... ..	73566	001
(3) Cairo City ... ..	30772	452
(4) Provincial Towns ... ..	41770	394
(5) Scavenging and Watering ... ..	30549	104
(6) Gas ... ..	20356	955
(7) Ezbekieh Gardens ... ..	2375	146
Total... ..	£E.221398	956

I will briefly discuss each of the above items.

#### (1) GENERAL DIRECTION.

This calls for no special remark. The sum represents the salaries of the Permanent Staff.

#### (2) PUBLIC BUILDINGS.

The following is the distribution of the charges :—

	£E.	Mill.
Temporary Staff ... ..	903	070
General charges ... ..	3664	100
Materials and Plant... ..	106	211
Repairs and Maintenance ... ..	68592	620
Total... ..	£E.73566	001

Of the above, the three first items explain themselves ; the charges are practically identical with those of former years. The last item, viz., Repairs and Maintenance, however, requires a few words of explanation. This represents the sum expended upon the up-keep of Public Buildings. At first sight, the sum appears a large one, but if the value of the existing Public Offices in Egypt be taken into account, the allotment for repairs falls to a percentage far below that allowed, under similar conditions, in Europe. Most of the Government offices, in Egypt, are installed in very old buildings, all of which are faulty in design and construction, and none of which were originally intended for the purposes for which they are now used. These buildings, owing to the employment of inferior materials in their construction, are steadily falling into decay. Each year, the question of their repair becomes more and more urgent, and each year, large sums of money are spent upon the worst cases. Expenditure upon such structures, however, very nearly approaches to waste of money. All that it can do is to slightly postpone the day when these constructions shall be pronounced unsafe. In the meantime, owing to the large proportion of the allotment which is thus used for patching up these old offices, the balance left available for the maintenance of the more modern buildings is reduced far below the requisite figure. Again, the sum shown in the above table, in no way represents the amount actually available for repairs. There are many charges which have to be met, which considerably reduce the total.

A very great deal has been done towards the erection of new Public Buildings in Egypt. The expenditure of the last ten or a dozen years testifies to this fact. Nevertheless, by far the larger proportion of the Administrations and Services is still housed in buildings which must undoubtedly, before many years, be condemned as dangerous.

### (3) CAIRO CITY.

The following are the details :

	£E. Mill.	
Temporary Staff ... ..	709	599
General charges ... ..	751	341
Plant and Materials... ..	1669	473
New Works ... ..	2191	915
Repairs and maintenance ... ..	22450	124
Total... ..	£E.30772	452

For the above sum, the whole of the Cairo roads are made and kept in repair. It also includes the expenditure upon Gardens, avenues, etc.

The total is utterly insufficient for the wants of a city like Cairo, but Mr Perry, by exercising rigid economy, obtains an astonishingly good result from the funds at his disposal. I shall speak of the Cairo roads later on.

(4) PROVINCIAL TOWNS.

	£E.	Mill.
Temporary Staff ... ..	564	750
General charges ... ..	651	938
Materials and Plant ... ..	0	050
New Works ... ..	1041	665
Repairs and maintenance ... ..	39511	991
Total... ..	£E.41770	394

The expenditure under this head is distributed among the local Committees of the different Provincial towns. It is controlled by a Permanent Committee, which sits in Cairo, and which is composed of Members of the different Government Services interested.

In all but five of the eighteen towns, subject to Tanzim regulations, local Commissions have been instituted. In 1901, two more will be added to the number.

The towns situated upon the Suez Canal, viz., Port-Said, Ismailia and Suez, are exempted from the control of the Permanent Committee above mentioned. Their expenditure is directed by the Ministry of Public Works. The town of Mansourah, again, is under a special arrangement, being endowed with a Municipality, exercising limited powers. In spite of difficulties at the commencement, this town can show good progress. It has established a system of electric lighting, and a project for the drainage of the rain-water is now in course of execution.

Mr. Perry enlarges upon the difficulties in connection with the expenditure of the other local Commissions and upon the waste of money which takes place, for want of due technical control. He gives several instances to prove his assertions. It is doubtless true that, hitherto, the funds, allotted to these towns, have been occasionally wasted, and that the local Commissions have at times landed themselves in situations from which they have only been extricated with difficulty, and at considerable cost. The system of local self government is of such recent date in Egypt, that failures at first, must be expected. It cannot, however, be denied that a general improvement is visible in most of the towns to which this privilege has been accorded. They are certainly cleaner than they used to be, and their roads are better kept. In many

places, public squares have been started, and attempts have been made to beautify the town. Technical control is doubtless required, wherever projects are contemplated, involving any considerable expenditure. Such control ought to be assured in the future, as an arrangement has been arrived at between the Ministries of the Interior and Public Works, by which 10% will be deducted from the annual Budget of each Town. The sum thus obtained, will be devoted to the formation of a technical staff, which will design and execute all future projects.

### (5) SCAVENGING AND WATERING.

The Cairo road area, cleaned and watered twice daily, is 1708545 metres square. The total road surface of the city is 2781742 square metres, so that approximately 61%, of the whole, is treated by the Scavenging Service.

In addition to the above, since August last, the whole native quarter is cleaned and watered once in every four days.

Mr. Perry, in his Report, gives a forcible illustration of the difficulties with which this Service has to contend, owing to the practice of the inhabitants of discharging the house refuse into the streets, at all hours of the day. He calculates that the amount of rubbish thus discharged, reaches the enormous total of 789 tons per diem. At the same time, he states, that the amount daily removed by the carts at his disposal is only 320 tons, or less than half the amount thrown out. The baths owners collect some 226 tons more, but there still remains a balance of 243 tons daily thrown out and not removed. If these figures are correct, at this rate, the Cairo streets will, in process of time, become completely blocked. That their level has been raised, by the rubbish of the past, admits of no doubt whatever. The sunken basements of the houses in the older quarters prove this. Nevertheless, it is difficult to imagine, that the daily rate of increase can be so great as is given above. However this may be, the amount, daily thrown into the streets, reaches a very high figure.

Mr. Perry gives the results of an experiment which he made in one quarter of the town to verify this. An area of 8000 square metres was watched by special inspection. The following was thrown out into the streets during a period of twenty-four hours.

624 pailfuls of slop-water.  
337 litres of night-soil.  
373 baskets of refuse.  
51 tins of ashes.

He estimates the credit annually required to clean the whole area of Cairo, at £E.39556. The actual sum expended in 1900 was £E.30549.

The work is most economically done; the average cost, per 1000 square metres of road, being about £E.17.5, as against £E.32, and over, for similar work in the chief towns of Europe.

The removal of rain-water, from the streets, is another source of trouble and expense to the Service, there being as yet no street drains. In February 1900, the establishment worked day and night, for four days, and removed 12528 tons of slush from the streets caused by one day's heavy rainfall. A project for the drainage of the storm-water has been sanctioned in 1901, and it is hoped that it will be completed before next winter.

All rolling-stock, required for the Scavenging and Watering Service, is built and maintained at the Government Arsenal. 424 animals are employed. The price of mules is, however, steadily rising. A few years ago, the smaller mules could have been bought for £E.17 a head. The present price varies from £E.25 to £E.30 per mule. The price of forage is also steadily rising.

Mr. Powell, the Director of this branch of the Service, and Mr. Fitzpatrick, his assistant, deserve the fullest credit for the manner in which they work it. Mr. Keith, who supervises the stables, also merits praise for the condition in which he turns out the animals under his charge.

### (1) THE LIGHTING OF CAIRO.

#### *Gas.*

There are 3171 gas lamps in Cairo, or about one quarter of the number required to light the whole city.

The cost of the above annually is approximately £E.20356.

475 extra lamps are urgently required. This would involve an additional annual expenditure of some £E.3100.

#### *Electric lighting.*

The Gas Co. has been given the concession for the above, but at present they are only compelled to furnish electricity to private houses, or to Government offices. The public lighting of the town does not enter into their liabilities. This method of lighting is increasing in favour, and the quantity of units sold in 1900 shows an increase of 37% over the year previous.

In order to meet the increased demand, the Company have laid 13 kilometres of new cable since last year. The consumption of current, in Cairo, is, as yet, small, compared to European towns of an equal population. This is largely due to the very variable demand. In the winter months, it is high, but, in the summer months, it is almost nil.

#### (7) THE EZBEKIEH GARDENS.

The total receipts, for the year, show a slight increase over 1899, being £E.1322.080 mill. as against £E.1300.

The Budget allotment is £E.2484.

The expenditure for 1900 is thus distributed:—

	£E.	Mill.
Water ... ..	775	257
Gas ... ..	499	008
Egyptian Band ... ..	326	695
Staff and labour ... ..	774	193
Seeds, stores and repairs ... ..	108	854
Total... ..	2484	027

The receipts of these gardens in 1896 were only £E.270666.

Great credit is due the Service for all that it has done to improve and beautify these gardens.

#### THE CAIRO ROADS.

I will very briefly allude to these roads, as I have discussed the subject at some length in more than one of my previous reports. I would refer anyone desiring fuller information to Mr. Perry's Note. The total area of road surface in Cairo, is 2781742 square metres. Of this area, 1361024 square metres are now macadamized.

The streets in which the traffic is heaviest, and the wear and tear consequently the greatest, have an area of some 550000 square metres. Of this surface, only 385000 square metres, or some 70%, can be maintained from the annual budget grant. This again, is only equivalent to some 14% of the total road surface of the city.

The criticism is often levelled at the Department, that everything is done for the European quarter of the city, and little, or nothing, for the native quarter. Mr. Perry's remarks on this subject are sound. The heaviest wheel traffic will naturally follow the widest and best aligned streets, and these are those which exist in the, so-called, European quarter of the city. These lines of main traffic must be maintained, and the Budget does not permit of any extension

whatever. Quite 80% of the carts, etc., which use these streets, belong to natives and benefit native industries.

Mr. Perry gives the areas of the six different classes of road existing in Cairo. These classes are made according to the importance of traffic. It will be seen, by referring to his report, that the 1st and 2nd classes of road, all of which are macadamized, and along which the heaviest traffic travels, amount to very nearly one half of the total area of road surface. The question of the Cairo roads is entirely one of funds. Mr. Perry has worked out an estimate for providing the whole city with first-class macadam roads.

The figures are very high :

	£E.
Initial expenditure including purchase of plant... ..	514541
Annual expenditure in maintenance, including scavenging and watering ... ..	157420

The annual charges, as above, are practically prohibitive.

An experiment is, at present, being tried, of putting down asphalte-bricks, laid upon a concrete foundation. Such a road costs £E.0.739 per square metre. If the experiment is a success, and if the necessary funds can be obtained, it is proposed to lay a considerable area of the streets, in the native quarter, with this material. The first cost is heavy, but the life of a road of this sort is very much greater than that of one laid with macadam, even when Basalt is used, as, is now the case, in all the first-class roads in Cairo. As a whole, the work done on the Cairo roads is very satisfactory. Any one contrasting those existing in the most frequented portions of the town, with those of a few years back, must allow that a marked improvement has resulted. The strictest economy has to be practised, to carry out even the present programme. Monsieur Reboul, who is actually in charge of the Cairo roads, deserves commendation for the success which he has attained in this direction.

(b) EXPENDITURE UNDER SPECIAL CREDITS PROVIDED  
BY THE CAISSE DE LA DETTE.

The following is the distribution :

	£E.
The Cairo Appeal Court and Prison ... ..	15647
New Arab Museum and Library ... ..	14307
New Egyptological Museum ... ..	43467
Sundry new Public Buildings ... ..	75085
Repairs to ancient Arab monuments ... ..	3564
Total... ..	£E.152070

Before describing the above, I will say a word about the last item. This money, although inscribed in the Public Works Budget, is controlled by a special Committee, whose duty it is to repair and preserve the interesting monuments of ancient Arab art which abound in Cairo. This Committee publishes the result of its operations in a separate annual report.

#### THE CAIRO APPEAL COURT AND PRISON.

This building was completed in 1900, the total cost being £E.102288. It is a handsome structure, covering an area of 6900 square metres. Unfortunately, it is surrounded, at a very short distance, by a mass of unsightly houses, which completely mask it and prevent the fine facade from being seen. It is contemplated, eventually, to remove these houses, but the cost of expropriating them will be heavy, and they must wait until other more urgent items calling for expenditure have been carried out.

Attached to this Court, is a Prison for 300 prisoners, with Police quarters above it. This prison is a four-storied structure, the corridors being carried upon cast-iron columns. After completion, a rather serious accident occurred to this prison. The base-stones, upon which these columns rested, cracked, as did the iron flanges of the bases of certain of the columns. The explanation given is, that the stones used were of too friable a nature to resist the pressure with security; also, that they were further weakened by the damp, and that the ironwork was faulty in some of its construction. With regard to this last, it cannot be denied that the columns in question were not suited to this particular structure. They were designed for another building, the construction of which was abandoned, and, with a view to economy, were made use of in this prison. The late experience has proved that the economy was a false one, and that it, in the end, entailed a considerable extra expenditure. With regard to the stones, there can be no sort of excuse. Stones of this quality, should never have been permitted in the work at all. The contractor has been heavily fined, but the officer charged with the superintendence of this building, cannot be absolved of blame in the matter.\*

\* The whole of the building has been repaired in 1901. The columns have been replaced by new ones, as have the foundation stones. This work was done without closing the prison, or without removing the Police from their quarters on the Upper or fourth story. The operation was a most difficult and delicate one, and great credit is due to all those in charge of it, of whom I would specially mention the name of Mr. Watson.



### THE ARAB MUSEUM AND LIBRARY.

The first storey is complete and the flooring of the second storey also. The building consists of two stories: on the ground floor, the Museum will be located, and on the first floor, the Library will find room.

The total floor area is 4880 square metres. The total expenditure up to date has been £E.34429. Of this sum, £E.14307 was spent in 1900.

The floors are of "béton armé." This work should be completed by November 1901.

### THE EGYPTOLOGICAL MUSEUM.

I would refer anyone requiring information regarding this building to Mr Perry's very full Note upon the subject. The total area covered by the structure is 12000 square metres, and the height, from the bottom of the nave to the dome, is, 34.55 metres. The masonry and the heavy work were completed in 1900, and the roof entirely covered. The external plastering is half finished and the internal, well advanced. Half of the mosaic floor also is complete. The results of the tests of the "béton armé" flooring and roofing have been satisfactory. There is still a mass of detail work to be done, but the building should be ready for use, in October 1901.

The arrangements, with the Army of Occupation, for the removal of the stables and outhouses which conceal the facade of the Museum, have been finally settled. The work of removal cannot, however, be as yet commenced, owing to the postponement of the construction of the new Barracks here.

A house is to be built for the Director General of the Museum, within the enclosure, and a railway line is to be temporarily laid between this place and the existing Museum of Gizeh. This will greatly facilitate the transport of the heavier statues. It is expected that the transfer will be commenced in January and February, 1902.

Mr Clifton, who has been in direct charge of this work, since 1897, deserves very great praise for the successful manner in which he has fulfilled a most onerous task.

The total expenditure up to date has been £E.175358. £E.43666 were expended in 1900.

### SUNDRY NEW PUBLIC BUILDINGS.

The list under this head is a long and varied one. It comprises Prisons, Schools, Tribunals, Slaughterhouses, Hospitals, Post-Offices ; also the Governorat offices at Port-Said. It includes a large number of buildings in Upper and in Lower Egypt, as well as in Cairo and Alexandria. Many of these buildings were completed in 1900, but some of them are still in progress. I shall not attempt to describe them, but will merely mention the more important works.

*Prisons.*—Four of these are in progress, viz., Manshia (Cairo), Tanta, Beni-Suef and Alexandria. They are all designed upon the very excellent type introduced by Coles Pasha, the Inspector General of Prisons. The designs are prepared by his architect, and the calculations are checked in Mr Perry's office. These prisons are all in an advanced state of progress, and £E.26765 was expended upon them from the Public Works Budget in 1900.

*Hospitals.*—In this instance also, the designs are prepared (mostly from type drawings) by the Sanitary Department, and the calculations checked by Mr Perry's architects.

Four Hospitals were in progress in 1900, viz., Alexandria, Minieh, Shibin-el-Kom and Assiout. The last was completed at a cost of £E.11025. The other two are still under construction, £E.6912 having been expended on them in 1900.

*Schools.*—The Esna school was completed last year, at a cost of £E.6800. In Cairo, two large schools were practically completed in 1900, viz., the Dar-el-Ulum and the Mubtadian.

The former, which has cost £E 7500, has accommodation for 100 pupils. This school is for the education of scholars of the El-Azhar University who desire to follow the career of Professor in the Government schools. The building contains, in addition to the class-rooms, a laboratory, library, refectory, reading room and prayer-hall.

The Mubtadian School, or old Nasrieh, is a much larger construction. It will cost, when finished, £E.25000. It is a primary school for boys, of ages ranging from 8 to 16 years. This school will hold 300 out-boarders and 100 in-boarders. It consists of three parallel ranges of buildings, within a large enclosure. The first block contains a library, drawing office, Professors' room and class-rooms. The second contains class-rooms, a refectory, prayer-hall and masters' room. The third, another, and larger, refectory, an infirmary, lavatory, kitchen and dormitories. The building has been designed in accordance with modern ideas.

*The Geological Museum.*—This was commenced in 1900, and will be completed in 1901. The total cost will be £E.4500, of which £E.2713 was expended last year. In addition to the collection rooms, it will contain a laboratory and testing room for analysing specimens and building materials.

*The Cairo Post-Office.*—The enlargement of this building was commenced in 1900, £E.3882 being expended out of a total credit of £E.12000. The foundations of this building, being bad, béton armé was used with excellent effect.

In addition to those already mentioned, a large number of smaller buildings were put in hand during last year. Among them were four slaughter-houses, three native courts of justice, three police Barracks and one house for reproducing maps by photography; also a dairy and cow-house for the Agricultural college, and an elephant house at the Zoological gardens. Upon the above, over £E.12000 were expended in 1900.

It will be seen from the foregoing, that a large amount of work in the shape of new buildings was in progress during the year 1900. The officers charged with the superintendence were Messrs Clifton and Hewat; the former in Lower, and the latter in Upper Egypt. The work of both was very heavy, and involved much travelling about and inspection at all seasons of the year. They both deserve praise for the satisfactory manner in which they performed their duties. Thanks to their efforts, the class of work everywhere, in Egypt, shows a marked improvement.

#### THE DRAWING OFFICE.

In this office, which is under the direction of Manescalco Bey, 63 projects were prepared in 1900, representing estimates to the amount of £E.280000. To give an idea of the work involved by their preparation, it may be mentioned that they necessitated 878 separate drawings. The staff employed cost £E.4710, or some 1.68% of the value of the proposed work. This rate is very low. In Europe it would have been some 2½%, which is equivalent to £E.14000.

Mr. Perry laments the absence of any information in Egypt, regarding tests and strength of building materials, as well as prices and contracts of labour, etc., etc. This is regrettable, but every thing must have a commencement, and for years to come the preparation of such statistics must form an important portion of his work. He must console himself by the thought that his successors, at any rate,

will benefit by the results of his experience. The preparation of his estimates is certainly hampered by the present want of reliable information upon all requisite subjects. At the same time, thanks to him, an improvement is already apparent, and each year his difficulties in the above respect will, I hope, decrease.

Arrangements have been made for the testing and analysis of all building materials, in the future, under the superintendence of Captain Lyons.

## THE CAIRO TRAMWAYS.

### *The Pyramid line.*

On the 1st of August 1900, the whole line between the Kasr-el-Nil Bridge and Mena House Hotel was in working order. At the point where it crosses the railway an over head bridge for carrying the tramway, is to be constructed, in order to avoid risk of accident. The Company has agreed to contribute £E.1300 towards its cost.

### *The Khaliq line.*

This was opened as far as Saida Zenab on the 1st of June. The modifications of the line at Ataba el-Khadra have also been completed.

An addition has been made to the rolling stock in the shape of some new cars. Most of the trains are now provided with 1st class compartments and reserved compartments for ladies.

A new tariff has been introduced with a uniform charge for each of the six sections. Stopping stations have been provided at a distance of every 250 metres along the line.

The total length of line is as follows:—

												Metres
Single track...	...	...	...	...	...	...	...	...	...	...	...	14783
Double track	...	...	...	...	...	...	...	...	...	...	...	20854
												<hr/>
Total...	...	...	...	...	...	...	...	...	...	...	...	35637.

The stock consists of 94 motor cars and 59 trailers. In 1899, 9,856,699 passengers travelled by these lines. In 1900, the number rose to 11,245,960.

## TANZIM LICENSES.

In 1900, 2398 "Rokhsas" or licenses were delivered, for construction of new buildings or repairs to existing ones: also for occupation of the public roads. The fees realised by the above were £E.1122,877 mill.

### THE ALEXANDRIA QUARRIES.

The rating of the quarry dues was until lately based upon the area exploited. A change of system was imperative, as almost every tenant surreptitiously extended the limits of his area.

The new system consists in levying an octroi duty upon the contents of every stone cart brought into Alexandria. The result of this innovation was very marked. In the first five months of 1900, when the old system was in force, the quarry dues amounted to £E.266. During the rest of the year, under the new system, they realised £E.1552. The new dues, however, fell hardly on the carters, and a strike resulted. The matter was arranged, and the law is now being recast.

### HELWAN WATER WORKS.

The working of this establishment has been satisfactory. The plant is in good condition and no failures have resulted.

The receipts for 1900 were £E.240 in excess of those for 1899, although owing to the low state of the Nile supplementary pumps had to be erected on the river bank. This fact, and the high price of coal, increased the year's expenditure by £E.785 above the normal. In spite of this, the gross profit for the year was £E.877.

### GHIZEH AND GHEZIREH WATER WORKS.

A supplementary grant of £E.1200 was allowed, in order to meet the high price of coal. Mr. Perry suggests the transfer of the Ghezireh pump to Ghizeh. The transfer would cost £E.3500, but would result in an annual economy of £E.400. The proposal is worth considering.

### STAFF.

I have already alluded to the good work done by Mr. Perry and certain of his assistants. In his report, he gives a long list of those to whom, he considers, praise should be allotted, and I cordially endorse his opinion. I would make special mention of the services of Sayyed Bey Choucry, who has had a very large district under his charge and who, during Mr. Perry's absence on leave, has carried on the duties of Director General in a very satisfactory manner.

Mr. Curtis, who is in charge of the Helwan and Ghizeh waterworks has done excellent work.

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## II.—THE SURVEY DEPARTMENT.

Captain Lyons has directed this Service, as usual, in a most efficient manner. Here, as in almost every other branch of the Public Works Department, the amount of work is increasing annually, and the aims and scope of the Service are being enlarged.

This Survey Department is divided into five separate sections:—

- (1) The Triangulation Survey.
- (2) The Revenue and Topographical Survey.
- (3) The Geological Survey.
- (4) The Drawing Office and Mapping Department.
- (5) The Meteorological Department.

The expenditure for 1900 was as follows:—

	£E.	Mill.
Permanent Staff ... ..	11839	368
Temporary Staff ... ..	14173	002
General charges ... ..	4233	756
Geological Survey ... ..	3014	533
Mis-cellaneous ... ..	1852	979
Total... ..	£E.35113	638

Of this total, a sum of £E.17422 is provided by the Ministry of Finance for the Revenue, or village survey. The balance, *i.e.*, £E.17691,638 mill. is found from the Budget of the Ministry of Public Works.

The following is a brief account of last year's work, which, as a whole, followed the same lines as that of previous years.

### TRIANGULATION.

The minor triangulation of the Fayum Province was completed. In the Provinces of Dakahlieh and Kaliubia, a considerable portion of the major triangulation was completed and in places, the minor triangulation was commenced. In Menufiyeh Province, the Theodolite traverse for the main portion of the chain survey was completed.

### REVENUE SURVEY.

Good progress was made in 1900. \*The revision of 780000 feddans, commenced in 1898, was nearly completed. Work is in progress in ten Markazes, in most of which it is approaching completion. A new

survey party was formed in August 1900. A sum of £E.1500 was allotted for this purpose. The following is the area treated in 1900 :—

Surveyed in the field ... ..	449540 feddans.
Land Registers completed for ... ..	972214 „

A marked improvement, in rapidity of working, has been shown in 1900. Thus in 1899, it took 118·5 days to complete the field work and registers of 1000 feddans. Last year the same area was completed in a period of 64 days.

The transfer of the offices of this Department to the new buildings at Ghizeh, has largely assisted in effecting a better out-turn of work.

#### THE GEOLOGICAL SURVEY.

The staff was chiefly occupied in the compilation of the results of previous years field work and in preparing them for publication. Captain Lyons, in his report, gives a list of the publications made in 1900 and of those which are almost ready to be published. When the new Geological Museum is open, the specimens, collected during the past three or four years, will be arranged and tabulated.

A great deal of work has been done by the Laboratory. Captain Lyons gives a list of the samples tested both for the Geological Survey and for the Buildings Department. A trial boring for water was made at Kafr-Dawar in the Province of Behera, with a view to ascertaining whether it was possible to obtain the water supply of the town of Alexandria from a subterranean source. The results were unsatisfactory. The experiment cost £E.339.

A commencement was made with the survey of the cataract region lying to the south of Wadi-Halfa. The survey party was accompanied by a geologist. A sum of £E.4200 has been granted for this work, which is estimated to require three years to complete.

#### THE MAPPING DEPARTMENT.

The number of map sheets printed and published was as follows :—

	Number of map sheets.	Number of copies printed.
Number of map ... ..	840	38025
Village maps... ..	34	19250
Total ... ..	874	57275

A new building for the photographic reproduction of maps was commenced in 1900.

The increase in the sale of maps was well maintained in 1900. 906 printed map sheets were sold and 103 books and reports. The following were issued free, for Government purposes:—

Printed map sheets...	...	...	...	...	...	...	...	...	...	20453
Books and reports ...	...	...	...	...	...	...	...	...	...	1738
Total ... ..										<hr/> 22181

The demands of the landowners in Egypt, to examine and purchase maps of their properties, has increased to such an extent, that a special room, in which maps can be studied and purchased, has had to be added to the survey offices. Two clerks have been appointed to control this work.

#### THE METEOROLOGICAL DEPARTMENT.

Daily weather reports have been issued since the 1st May, 1900. Secondary meteorological stations have been equipped at Port-Said, the Barrage, Assiut and Assuan. From these, as well as from Alexandria and Omdurman, telegrams are despatched to the Abbassia Observatory, daily, at 8.30 a.m., reporting on the weather. These messages are corrected and prepared for daily publication. The results are lithographed and distributed each day, between noon and 1 p.m. Thanks to the liberality of the Eastern Telegraph Company, who have consented to transmit the daily weather telegrams over their cables, free of charge, it has been arranged with the Meteorological services of Malta, Italy, Austria and Greece that the above shall be interchanged with those of Egypt. Upon the receipt of these foreign telegrams, at the Cairo central Observatory, a “résumé” is telegraphed to the Port-Office at Alexandria and Port-Said, where the information is posted for the information of the shipping.

Rain gauges have been established at Taufikia, on the White Nile, and at Rosaires, on the Blue Nile. Also at Kassala and Suakin.

The equipment of the Abbassia Observatory, as a station of the first order, is now complete. The atmospheric pressure, the temperature, humidity, direction and force of wind and the duration of sunshine are all recorded continuously by self-registering instruments. Time observations, for the control of the standard mean-time clock which automatically transmits the noon signal, are regularly made. In October, 1900, arrangements have been made with the Telegraph Department, to transmit this signal to out-stations. A Time-ball is dropped automatically at Port-Said and a signal sent daily to Wadi-



Halfa. The arrangements for the time-ball at Alexandria and for firing the noon-day gun at the Cairo citadel will be completed early in 1901. From the 1st of September, 1900, universal time was employed, and since that date, the civil time for Egypt has been that of the 30th Meridian, East of Greenwich, or two hours in advance of Greenwich mean time.

The Milne's Seismograph has worked regularly throughout last year, but the magnetic observations at Heluan were interrupted for a period of six months, owing to the want of an observer.

Captain Lyons is gradually collecting around him a highly trained staff of scientific men.

### III.—THE TECHNICAL SERVICE.

This Branch of the administration is directed by Mohamed Bey Anis. He has controlled his service very satisfactorily and deserves great praise for the results of his year's work.

The expenditure for 1900 was as follows:—

	£E.	Mill.
Permanent Staff ... ..	5412	321
Temporary Staff ... ..	2475	559
General expenditure ... ..	620	977
Materials and plant... ..	1063	579
Repairs and maintenance of Government steamers ...	4704	986
Total... ..	£E.14277	422

The last item is subdivided as follows:—

	£E.	Mill.
Cost of working steamers ... ..	2057	293
Repairs and maintenance of steamers ... ..	2603	779
Petty expenses ... ..	43	914
Total... ..	£E.4704	986

### THE GOVERNMENT ARSENAL.

The above expenditure does not include that incurred by the Government Arsenal. This institution, which is self supporting has the following record to show for 1900:—

	£E.	Mill.
Work done for Public Works Department ... ..	25285	000
.. .. for other Government Services ... ..	670	000
.. .. for private individuals ... ..	450	000
Cost of coal, oil, etc. ... ..	2238	000
Total... ..	£E.28643	000



## THE CENTRAL STORES.

Purchases to the value of £E.996,199 mill. were made in 1900. Goods to the value of £E.1185,311 mill. were delivered to different Departments.

### *Staff.*

Mr. Crawley, the Government Inspector of Engines, has rendered excellent service, in controlling and in inspecting the different establishments. Mr. H. Curtis, in charge of the Government Arsenal, has worked up his usual very high standard of efficiency.

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## IV.—THE MUSEUM AND ANTIQUITIES DEPARTMENT.

The progress, in all branches of this Service, due to the energy and administrative ability of Monsieur Maspéro, the Director General, has been very marked. He has submitted a long and interesting Note, regarding the results obtained in 1900, which note I have added as an appendix to this Report. It is very full of detail and, in it, he indicates the measures which, in his opinion, should be taken to increase the efficiency of his service. I will, therefore, very briefly allude to those points of his note which seem to me to possess the greatest interest.

### ADMINISTRATION.

Previous to 1900, the Antiquities Service was divided into seven administrative circles, each under the direction of a subordinate official. This distribution did not respond to the necessities of the present day, and in the beginning of last year, two English Inspectors in Chief, Mr. Quibell and Mr. Howard Carter, were appointed. At the same time, the occasion was seized to redistribute the Circles more in accordance with the altered condition. The duties of these two officers are, to generally inspect the different monuments and report upon their state, to prevent further mutilation or destruction, and to stop, as far as possible, illicit digging. M. Maspéro speaks highly of the services rendered by these two gentlemen, but considers that their respective charges cover much too large an area. I am glad to say that he also recounts a marked improvement in the work done by the Egyptian Inspectors.

*Ghaffirs.*

There are two classes of watchman. The one permanent, and the other temporary. The number at present employed are:—

Permanent..	...	...	...	...	...	...	...	...	...	191
Temporary..	...	...	...	...	...	...	...	...	...	285

The wages of these watchmen involve an annual expenditure of some £E.2,162, of which £E.695 is met from the Budget, and the balance from the Tourist's and Quarry funds. Even the above number is insufficient to effectually guard the monuments. Mr. Maspéro, wishes to appoint two watchmen at each place, one for day work and one for night work. For the present, the Budget does not permit of this. The Ministry of the Interior has, however, ordered the local Mamurs, Omdehs and Police officers to undertake the watching of all sites to which no ghaffirs are appointed. These officials are also charged with giving assistance to the watchmen, in case of need.

*Sale of old materials and "Sebakh."*

By an arrangement made with the Ministry of Finance, the funds, realised from the above, are placed at the disposal of the Antiquities Service.

With regard to "Sebakh," (the debris of old towns largely used by the fellahin as manure) the removal of this material is now controlled and regulated. Ghaffirs are appointed to each "Tell," or mound covering the site of an ancient town. Their wages are paid by the people wishing to remove the "Sebakh," and the localities in which it may be so removed are limited and marked out by the Museum Department. Mr. Maspéro laments the incalculable loss of precious objects, more especially of papyrus manuscripts, which has taken place in the past, owing to the unregulated excavation of these mounds.

*Excavation.*

M. Maspero gives a full account of the work done by the different Societies, and by the Museum itself. Any one desiring information regarding this subject, will find much of interest in his report.

*Repairs.*

Good progress was done in the way of restoring and safeguarding the different temples. One of the most important repairs was the

enclosure of the chief monuments at Thebes, by walls, and by placing iron gates at the entrances. The tomb of Amenhotep II, opened some three years ago, has been so arranged that the Royal mummy has been left in its sarcophagus, without risk of danger from exposure to the air.

*The Karnak Temples.*

The accident to the columns of the great Hall was described in last year's Report. Measures were taken, in 1900, to lessen, as far as possible, the risk of any further subsidence. A credit of £E.4000 was granted for this purpose by the Caisse de la Dette. This sum included the strengthening of the great pylon, a portion of which menaced ruin. The fallen columns were removed, as well as those which threatened danger. Each stone, of the above, was separately numbered, and placed in order outside of the building, so that if it is even decided to rebuild these columns the work will be greatly facilitated. These repairs were completed by the 24th of May. Very great credit is due to Messrs Legrain and Ehrlich who were charged with the work. To the former was entrusted the very difficult task of removing the columns, and to the latter, that of repairing the Pylon. The flood of 1900, passed without causing any further damage to this temple.

BUDGET FOR THE YEAR 1900.

The expenditure for the year, under the regular Budget, was as follows:—

	£E.	Mill.
Permanent Staff... ..	6848	309
Temporary Staff... ..	2498	671
General expenditure ... ..	<u>2606</u>	<u>811</u>
Total... ..	£E.11953	798

To this must be added:—

	£E.	Mill.
Receipts from the Tourist Fund. ... ..	2719	350
Entry to Museum ... ..	557	100
Sale of objects ... ..	<u>419</u>	<u>270</u>
Total... ..	£E.3695	720

The amount realised from these three sources, is less by some £E.1400, than in the year 1899. The money so derived does not appear in the Budget of the Museum Service. It is applied solely towards the maintenance and guardianship of the temples, and the expenditure is controlled by a permanent Committee, of which M. Maspéro is the President.

### THE GHIZEH MUSEUM.

681 new objects were added to this collection in 1900. M. Maspéro gives a list of the more important ones. Preparations are well in hand for the transfer of the Museum to Cairo. Ten of the halls, of the first floor, have been emptied of their contents, which have been packed in cases, and are now awaiting removal.

### THE MUSEUM LIBRARY.

M. Maspéro is gradually forming an important library. £E.272,615 was spent in 1900, in the purchase of new volumes and in rebinding existing copies.

### THE MUSEUM CATALOGUE.

By the end of 1899, it was found necessary to make some alterations in the character of this work. According to the original programme, it ought to have been completed by November 1900, for a total expenditure of £E.6000. It was, however, commenced in so elaborate a manner, that by the end of 1900, the funds were nearly exhausted, with only a portion of the work completed. At M. Maspéro's proposal, and with the approval of the Egyptological Committee, the style of the work was altered. A fresh credit was granted by the Caisse de la Dette and a sum of £E.4000 was thus added to the Museum Budget, for a period of six years. Up to the end of 1900, six portions of the catalogue were published and two more were in progress.

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## V.—AGRICULTURAL RAILWAYS.

Mr. Cotterill's note is attached to this report. It gives a very clear "résumé" of the working of the lines during the year 1900. With one exception,\* the progress made has been fairly satisfactory.

In December 1899, the Delta Light Railway and the Eastern Light Railway amalgamated and are now worked by one board of Direction.

By the end of 1900, 924 kilometres (574.5 miles) of Light Railway were open to traffic in Egypt.

386 miles of telegraph and telephone wire were laid in connection with these lines.

\* The Fayum Light Railway.

With few exceptions, the Companies have abandoned level-crossings wherever their lines meet the State Railways. In almost every case, subways, or overhead bridges, have been constructed. The wisdom of this measure has been exemplified, as a serious accident took place lately at one of the few level-crossings still existing.

The cost of construction has been as follows :—

The Mansourah-Matarieh Railway	... ..	£E. 2285 per kilometre.
The Eastern Railway System	... ..	.. 1550 ..
The Delta Railway System	... ..	.. 1093 ..

The Mansourah line has a gauge of 1 metre ; the other two, of only 0.75 metre, the figures for the Fayoum Railway System have not been obtainable.

The minimum passenger rates are as follows :

Mansourah-Matarieh Railway	... ..	0.4 pence per mile.
Eastern Railway	... ..	0.6 .. ..
Delta Railway	... ..	0.45 .. ..
Fayoum Railway	... ..	0.55 .. ..

The number of passengers using these lines has exceeded the forecast on the first three of the above companies the average is about 4200 passengers per kilometre per annum.

Goods traffic on the contrary has been less than was expected. This is largely due to the short leads and the competition of camels, donkeys and boats. Each year, however, the goods traffic is increasing.

These lines have met a great want, and have opened up the Provinces in which they exist in a very considerable degree. The value of land in their vicinity has largely increased, since their construction.

## VI.—THE CENTRAL OFFICE.

The expenditure charged to this head is given in Table I of this Report.

It was as follows :—

	£E.	Mill.
(1) Permanent Staff	26363	157
(2) Temporary Staff	1738	760
(3) General expenses	4560	529
(4) Material, furniture, etc	22	868
(5) New works	8204	856
Total	£E.40890	170

The only item requiring explanation is No. (5). The following is the detail :—

	£E.	Mill.
Cairo Opera House subvention & Staff ... ..	6011	808
Maintenance of above ... ..	507	368
Arab Monuments... ..	979	680
Models & books for Polytechnic School ... ..	706	000
Total ... ..	£E.8204	856

The expenditure, as regards supplementary works, in connection with the Nile Reservoirs, which in 1899, was included in the central office charges, has this year been added to the expenditure upon irrigation works, which is its proper place.

#### THE CENTRAL OFFICE STAFF.

I regret to say that Monsieur Nicour Bey, the Secretary General, has been much hampered in his duties by continual ill-health, which has necessitated a long absence from Egypt.

I must again bear testimony to the very excellent services rendered by Farid Bey Babazogli, the "Chef du Service Administratif" at the Ministry of Public Works. I can only repeat what I said last year, viz., "that his services have been simply invaluable." The work done by the branch under his control is yearly increasing and there are few harder-worker officials in the Department.

If I do not mention the names of many of his subordinates, it is not because I do not appreciate their good work, but simply because the list would be such a large one.

My own Arabic clerk, Abdel Kerim Effendi, has again rendered me great assistance in his particular branch, as has Mr. Olivier Bey, in the preparation of the figures which appear in this Report.

W. E. GARSTIN,

*Under Secretary of State  
for Public Works.*

Cairo, 12th of July, 1901.





ADMINISTRATION REPORT  
OF THE  
IRRIGATION DEPARTMENT IN UPPER EGYPT  
For 1900

BY  
K. VERSCHOYLE.  
*INSPECTOR-GENERAL OF IRRIGATION, UPPER EGYPT.*



# ADMINISTRATION REPORT OF THE IRRIGATION DEPARTMENT IN UPPER EGYPT, 1900.

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## Part I.—IRRIGATION AND DRAINAGE.

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### SECTION I.—THE NILE.

At the commencement of the year the level at Aswan was 85·89. At Assuan, which level is 1·78 metres below the average of the twenty years ending with 1892. The following table gives the level for the 1st of each month of the year and 31st of December compared with the average level on those dates for the twenty years ending with 1892:—

January, 1st, 1900	Aswan Gauge was	1·78	below average.
February, 1st, 1900	..	1·85	..
March, 1st, 1900	..	1·58	..
April, 1st, 1900	..	1·36	..
May, 1st, 1900	..	1·00	..
June, 1st, 1900	..	0·81	..
July, 1st, 1900	..	1·02	..
August, 1st, 1900	..	2·05	..
September, 1st, 1900	..	0·14	..
October, 1st, 1900	..	0·45	..
November, 1st, 1900	..	1·00	..
December, 1st, 1900	..	0·78	..
December, 31st, 1900	..	0·68	..

The minimum gauge of 84·07, which is 0·94 below the average, was recorded on the 15th of May, eleven days earlier than the average date. On the 1st of June matters had somewhat improved, the level on that date being 0·81 below the average. The improvement was not however maintained.

The real rise commenced on the 9th of July, but, after continuing fairly rapid up to the 20th of that month, halted badly, with the result that on the 1st of August the level was no less than 2·05 below the average. From the 1st of August the pace improved rapidly, and the maximum gauge of 92·91, reached on the 19th of August, was 0·01 above the average. On this latter date there appeared every probability of a favourable flood.

From 19th of August to 12th September, with the exception of four days, during which there was a small rise of nine centimetres, the fall was continuous.

On the 12th September the gauge was 91·76. Between the 12th and 19th of September there was a slight recovery of 47 centimetres, which brought the gauge up to 92·23. From 19th September to 5th October there was a slow fall, the gauge on the latter date being 91·81. From the 5th October the fall was rapid and continuous up to the beginning of November, when the gauge was 1·0 metre below the average. From the beginning of November the rate of fall moderated and the level on the 31st December was 86·99 which is 0·68 below the average.

The levels on 31st December 1877 and 1900 were exactly the same. On 31st December, 1888, the level was 0·36 lower, and on 31st December, 1899, 1·7 lower than on the same date in 1900. During the last twenty-nine years, with the above exceptions, the level at end of December was always higher than that recorded in 1900.

Summing up, the river level was much below the average during the summer months. The rise was early and fairly rapid, and the maximum level attained was average. The fall commenced on the 20th of August and, with the exception of one feeble rise, continued rapid till the beginning of November when the pace moderated. The year 1901 commences with a level 0·68 below the average, which is 1·10 better than the record low-level at the beginning of 1900.

At Asyut.

The following statement shews the average of the daily gauge readings at the head of the Ibrahimiyah Canal during the summer months of 1900 and nine typical years:—

YEAR.	AVERAGE GAUGE READINGS AT ASYUT DURING				Nature of Summer Levels.
	April.	May.	June.	July.	
1899	46·50	45·91	45·47	46·52	High.
1897	46·09	45·70	45·66	46·89	do.
1884	46·17	45·68	45·50	46·48	do.
1885	45·52	45·13	44·87	47·25	Fair.
1894	45·26	45·01	45·08	49·13	do.
1883	45·57	45·19	45·03	45·77	Low.
1898	45·42	45·09	44·90	45·84	do.
1889	44·99	44·75	44·57	45·60	Very low.
1892	45·24	44·77	44·58	45·55	do.
1900	44·89	44·88	45·17	46·19	do.

This statement shews that the level in April was lower than in any of the other selected low years, but in May it was only below the low years of 1883 and 1898, while in June and July it exceeded all the other low years. These high levels are undoubtedly due to the saddling of the river in connection with the Asyut Barrage works, a fact which renders it impossible to compare the summer levels recorded on the Asyut gauge during 1900 with those of previous years.

The minimum gauge of 44·80 was recorded at Asyut on the 16th of April. Looking at the Aswan gauge the minimum should have been recorded about the 23rd of May when the next minimum of 44·87 actually did occur. The transposition of dates, by which the Asyut gauge recorded its minimum before that of Aswan was, of course, due to the advance of the sabbis in the river at the former site. The rise between the 23rd of May (the date of the true minimum) and 14th of July was very slow, the level on the latter date being 45·69. Between the 14th and 28th of July the rise was rapid, when a hull lasting till 4th August occurred. From 4th to 23rd August the rise again became rapid. The maximum level of 51·67 was reached on 23rd August. This level was 1·03 higher than the maximum of 1889. The average maximum level at Asyut for the sixteen years ending with 1899 is 52·17. The maximum level of the very favourable flood of 1898 was 52·64 or 0·97 higher than the maximum of 1900. After reaching the maximum on 23rd August the level kept steady for four days, when a fall set in lasting up to the 17th of September. From the latter date the level fluctuated up to the 19th October when the fall became continuous.

The following statement gives the lowest and highest levels recorded above and below the 1st Cataract during the past four years. The low levels above the Cataract during the past year are of no value for purposes of comparison owing to the Reservoir works:—

SITE	1897			1898			1899			1900		
	Lowest	Highest	Difference	Lowest	Highest	Difference	Lowest	Highest	Difference	Lowest	Highest	Difference
Philæ .. .. .	R.L. 40.56	P.L. 97.95	M.L. 7.39	R.L. 89.71	P.L. 91.05	M.L. 9.31	R.L. 90.70	P.L. 97.00	M.L. 6.30	R.L. 91.20	P.L. 98.54	M.L. 7.34
Aswan .. .. .	85.62	92.80	7.18	84.74	93.63	8.89	85.15	91.67	6.52	84.07	92.91	8.84
Difference ...	4.94	5.15	0.21	5.00	5.42	0.42	5.55	5.33	0.22	7.13	5.64	1.49

The following statement gives the lowest and highest levels recorded on the different river gauges south of Aswan since 1897:—

SITE	1897			1898			1899			1900		
	Lowest	Highest	Difference	Lowest	Highest	Difference	Lowest	Highest	Difference	Lowest	Highest	Difference
Khartoum	M.L. —	M.L. —	M.L. —	M.L. —	M.L. —	M.L. —	M.L. 0.24	M.L. 5.37	M.L. 5.13	M.L. 0.70	M.L. 4.04	M.L. 3.34
Berber .. ..	—	—	—	—	—	—	—	—	—	0.11	4.67	4.56
Kerni .. .. .	1.00	5.67	4.67	0.80	6.47	5.67	0.98	4.80	3.82	0.88	5.50	4.62
Halla .. .. .	1.86	8.00	6.14	1.09	8.72	7.63	1.46	6.92	5.46	0.96	8.06	7.10

The Berber gauge was only recorded from 4th May. The minimum level was probably reached some fifteen days earlier, and was 15 to 20 centimetres lower than the level on 4th May. The average maximum gauge at Halfa deduced from the records of the past twelve years is 8·24.

Sennaar Gauge,  
Blue Nile

The readings of a gauge at Sennaar on the Blue Nile were recorded from April. The minimum reading of 0·02 was recorded on 28th April, the maximum of 7·64 on 6th August. The total rise was thus 7·62.

## SECTION II.—SUMMER IRRIGATION.

The volumes entering and utilized in the Ibrahimiyah Canal during the summer months of the last seven years, and the very low years 1898 and 1892 are given below in cubic metres per second, together with the dates of complete closure of the Deirut Escape :—

YEAR	APRIL		MAY		JUNE.		Date of complete closure of the Deirut Escape.
	Discharge at head.	Discharge utilized.	Discharge at head.	Discharge utilized.	Discharge at head.	Discharge utilized.	
1889	37·1	37·1	32·5	32·5	26·4	26·4	15th February.
1892	18·4	18·4	36·1	36·1	29·5	29·5	9th March.
1894	65·1	65·1	58·3	58·3	56·8	56·8	16th March.
1895	121·2	84·2	92·1	87·7	81·7	81·7	12th May.
1896	100·2	86·2	75·7	75·7	64·6	64·6	16th April.
1897	115·4	81·4	100·9	81·4	82·8	82·8	17th May.
1898	62·7	62·7	59·5	59·5	47·3	47·3	26th March.
1899	145·1	96·5	123·5	118·4	83·0	83·0	1st June.
1900	46·9	46·9	41·9	41·9	49·4	46·1	14th February.
			46·6	41·8	64·6	64·6	Resopened on 29th May Closed again 16th June

The Deirut Escape was closed on the 14th February and remained closed up to the 20th May, during which time the total supply entering the canal was utilized. On 29th May the Escape was opened to augment the river supply for the benefit of Lower Egypt, it being considered that, owing to the holding up of the river at Assiout by the New Barrage Works, the Ibrahimiyah Canal was getting more than its share of the available supply. The Escape remained partially open till the 16th June. In the above statement allowance is made for this opening of the Escape by giving two discharges for May and June, and shewing proportion of each utilized. The discharge shewn for the second half of May is the mean of the discharges observed on the

15th May and 1st June. A discharge of the Escape was observed on the 1st June from which is deduced the volume utilized during the second half of May. Mr. Clowes, Inspector of Irrigation, 4th Circle, notes that this Escape discharge of the 1st of June was much lower than that of the 20th May, and that consequently the volume actually utilized during the second half of May was less than shewn.

A study of the above statement shows that the discharge of the Ibrahimiyah in April was lower than in any previous year, for which records exist, except the record low year 1899. In May the discharge was considerably better than in either of the low years 1889, 1892 and, in June it got in front of 1898 also, owing to the early rise of the river.

Little difficulty was experienced in meeting the demand for irrigation except for a few days in the Fayum.

The usual rule was followed of giving to the Bahr Yusuf at Deirut Fayum supply one-fourth of the discharge of the Ibrahimiyah Canal at Deirut plus 100,000 cubic metres. The lowest discharges of the Bahr Yusuf below Lahun recorded in each of four years of high and five years of low supply are as follows:—

YEAR	DISCHARGE IN CUBIC METRES PER 24 HOURS	
	High Years.	Low Years.
1900	—	16th June, 799,574
1899	25th June, 1,163,409	—
1898	—	2nd July, 1,033,124
1897	15th June, 2,298,067	—
1896	2nd July, 1,620,885	—
1895	1st July, 1,876,264	—
1894	—	900,987
1892	—	584,312
1891	—	645,400

The discharges during the summer months of 1898 and 1900 inclusive are as follows:—

1898.		1899.		1900.	
Date.	Discharge in c. m. per diem.	Date.	Discharge in c. m. per diem.	Date.	Discharge in c. m. per diem.
April 15th ...	2,953,651	April 15th ...	1,228,456	April 1st ..	1,837,481
May 17th ...	2,481,170	May 17th ...	2,970,259	April 16th ...	1,339,683
June 12th ...	1,560,325	June 16th ...	1,475,529	May 1st ...	1,235,699
July 2nd ...	1,033,124	June 25th ...	1,163,409	May 17th ...	1,418,866
July 16th ...	2,561,322	July 1st ...	1,901,017	June 2nd ...	1,085,937
		July 17th ...	2,337,467	June 16th ...	799,574
				July 1st ...	1,900,407
				July 16th ...	2,027,959



The lowest discharge recorded in 1900 was that of 16th of June, observed when the down-stream level at Lahun was 22.46. The gauge had been half a metre lower a few days previously, so the minimum discharge was considerably below 799,574 cubic metres.

The area of summer crops in the Fayum is given both by the Finance and the Chief Engineers as 43,183 feddans. At 25 cubic metres per feddan per diem this area would require a daily discharge of 1,079,575 cubic metres. It is therefore evident that for the greater part of June the supply was deficient, but during the other summer months was ample.

The accompanying diagram shews the up and downstream levels at the Lahun Regulator on the Bahr Yusuf, through which the Fayum receives its supply, and also at Hawarah Regulator some 10 kilometres lower down.

At the top of the diagram is shewn the system of rotations followed during the past summer on the Bahr Yusuf.

Proposed new  
branch canal  
from the Bahr  
Yusuf for  
irrigation of  
the Fayum.

In the annual report for 1899 Mr. Webb noted that the maximum flood discharge in the Bahr Yusuf reaching the Fayum was 8,000,000 cubic metres per diem or 92 cubic metres per second, and that the cultivated area being 330,000 feddans a discharge of 114 cubic metres per second, or 30 cubic metres per feddan per day, was required. It was therefore necessary to augment the flood discharge by 22 cubic metres per second. To provide this extra discharge Mr. Webb advocated the construction of a new canal taking out from the Bahr Yusuf above the Lahun Regulator to feed the Gharaq, Azab and Nezliah canals. The Bahr Yusuf below Lahun would thus be relieved of about one-third the area of the Fayum Province. The project has been worked out and the new canal will be constructed in 1901 to carry a discharge of 40 cubic metres, the revised area of the Fayum being taken at 380,000 feddans, including all "Kharig el Zimam," instead of 330,000 feddans.

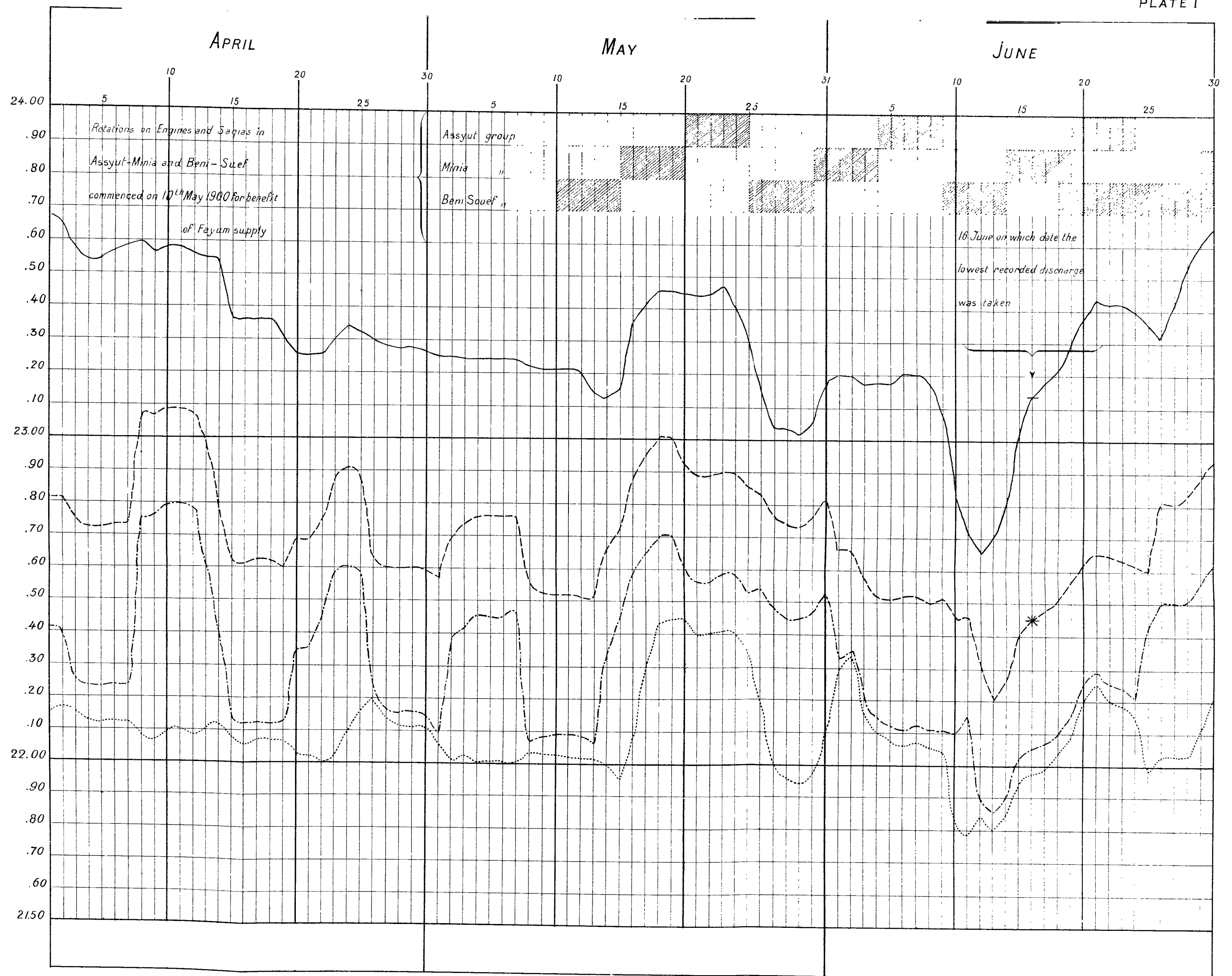
Regulation  
on the  
Ibruhimiyah  
Canal.

As noted above a certain amount of water was passed through the Deirut Escape for the benefit of Lower Egypt during the summer months. The amount of water so escaped was regulated as follows. The canal gauges at Deirut were regulated according to the level recorded by the Sohag river gauge four days before. For every centimetre of rise or fall at Sohag the levels of the Deirut gauges noted below were, four days later, raised or lowered by the same amount. The datum levels fixed were as follows. A level of 53.46 on the

# DIAGRAM OF GAUGES OF BAHR YUSEF

## LAHUN & HAWARAH REGULATORS

PLATE I





Sohag gauge was taken to correspond, before the river was interfered with at Asyut, with the following gauges at Deirut :—

Upstream of Deirut Regulator ... ..	43.20
Downstream in Ibrahimiyah Canal ... ..	43.00
Downstream in Bahr Yusuf ... ..	42.50

The Deirutiyah and Saheliyah canals were, as usual, left fully open, any excess water resulting from this system of regulation was discharged into the river by the Deirut Escape. Mr. Moser, Surveyor of Contracts, was stationed at Deirut to see that the regulation was correctly carried out. The regulation was commenced from 17th May, taking the Sohag gauge of that date to effect the Deirut gauges of 21st. As the Sohag gauge on the 17th May was 53.44, or two cents below the datum, the Deirut gauges had to be lowered two centimetres below their datums by opening the Deirut Escape. Under this arrangement the Deirut Escape remained open from 20th May to 16th June. Orders to discontinue the regulation were issued on 25th June by which date the Rodah gauge had risen 0.21 above its minimum.

Mild rotations were commenced on the Ibrahimiyah Canal from 19th February in the Minia Province. General rotations on canal heads in the Minia and Beni Suef Provinces commenced on 10th March. There were three classes of rotations of increasing severity as shewn by the following statement :—

CLASS	PERIOD OF ENFORCEMENT	FREQUENCY OF WATERINGS			
		Minia	Beni Suef	ASSUT	
				Saheliyah Canal.	Deirutiyah Canal.
I	10th March to 16th April.	Once in 19 days	Once in 22 days	Once in 16 days	Once in 19 days
II	16th April to 10th May.	Once in 22 days	Once in 24 days	Once in 18 days	Once in 22 days
III	10th May to 15th July.	Once in 24 days	Once in 26 days	Once in 20 days	Once in 24 days

The following statements show the number of days of supply and stoppage for each class in the several provinces :—

ROTATION TABLE, IBRAHIMIYAH CANAL.

PROVINCES.		MINIA						BENI SUFF.	
CLASS OF ROTATIONS		Minia.		Matru.		Mazaga		Sharahna.	
		NUMBER OF DAYS.							
		supply.	stoppage.	supply.	stoppage.	supply	Stoppage	supply	stoppage.
Class	I ...	7	12	6	13	6	13	10	12
..	II ...	8	14	7	15	7	15	11	13
..	III ...	9	15	7½	16½	7½	16½	12	14

ROTATION TABLE ON SAHELIIYAH AND DEIRUTIIYAH CANALS IN ASSIOUT.

CANALS.		SAHELIIYAH CANAL				DEIRUTIIYAH CANAL				
REGULATORS		KARAMUN.				QOLOBBA.				
		Above		Below.		Above		Below.		
CLASS OF ROTATIONS.		NUMBER OF DAYS								
		supply.	stoppage.	supply	stoppage.	supply	stoppage.	supply	stoppage.	
Class	I	...	8	8	8	8	10	9	9	10
..	II	...	9	9	9	9	12	10	10	12
..	III	...	10	10	10	10	13	11	11	13

In the Fayum Province only one class of rotations was enforced allowing one watering in twelve days. The canals are divided into sections and each section is accorded a period of working proportional to the area on it. The sum of the periods of working on the several sections of any canal amounts to twelve days. The system appears complicated on paper, but Mr. Clowes assures me that it works well, and is perfectly understood by the cultivators. These are weighty recommendations in its favour, and should make one hesitate to introduce any alteration. This rotation remained in force from the 1st April to 20th July. Besides the above rotations, on canal and water course heads, rotations were enforced on lifting machines as follows :—

ROTATIONS ON LIFTING MACHINES.

NAME OF CANAL	Period of Rotations	Nature of Rotations
Ibrahimiyah Head to Deirut	10th April to 15th July	9 days working 9 days stoppage.
Sahelivah Canal	22nd May to 10th July	8 .. .. 10 .. ..
Deirutiya Canal	do do	7 .. .. 11 .. ..
Bahr Yusuf Head to Lahm	10th May to 15th July	10 .. .. 10 .. ..
		11 .. .. 13 .. ..
		5 .. .. 10 .. ..

The areas under Cotton irrigated by the Ibrahimiyah Canal in the past five years are as follows:—

The Cotton Crop.

In 1896	...	...	...	...	...	75,134 feddans.
„ 1897	...	...	...	...	...	90,696 „
„ 1898	...	...	...	...	...	100,005 „
„ 1899	...	...	...	...	...	90,887 „
„ 1900	...	...	...	...	...	92,842 „

The following statement, which has been kindly furnished by Mr. Wakeham, Agent of Messrs. Carver Brothers in Upper Egypt, shews the out-turn of the ginning factories in the different provinces during the past eight seasons:—

PROVINCE.	OUT-TURN IN KANTARS.							
	1893-94	1894-95	1895-96	1896-97	1897-98	1898-99	1899-1900	1900-1901
Beni Suef ... ..	85,000	120,000	150,000	154,000	178,000	143,000	139,000	131,000
Minia ... ..	30,000	50,000	82,000	107,000	125,000	74,000	105,000	104,000
Fayum ... ..	75,000	90,000	130,000	138,000	163,000	137,000	170,000	130,000
Totals. . . . .	190,000	260,000	362,000	399,000	466,000	354,000	414,000	365,000
Average price per kantar	P.T.210	P.T.165	P.T.205	P.T.205	P.T.162	P.T.156	P.T.205	P.T.275

The following statement gives the area in feddans of cotton irrigated from the Ibrahimiyah Canal in the different provinces during the past three years:—

YEAR.	Assut.	Minia.	Beni Suef.	Fayum.	TOTAL.
1898	2,635	19,580	26,253	51,537	100,005
1899	1,874	20,576	22,277	46,160	90,887
1900	2,753	27,912	26,086	36,091	92,842

The area under cotton was some 2,000 feddans greater than in 1899 and about 7,000 feddans less than the bumper year of 1898. There was a large reduction of 10,000 feddans in the Fayum where the area was restricted owing to the expectation of a low supply. The out-turn was considerably below the average, being 14% below that of 1899.

Sugar-cane.

The following statement gives the quantities of cane crushed in the chief factories in Upper Egypt and the out-turn of No. 1 Sugar during the past four seasons:—

Factories.	SEASON 1897-1898			SEASON 1898-1899			SEASON 1899-1900			SEASON 1900-1901		
	Cane crushed	Out-turn No. 1 Sugar	Percentage	Cane crushed	Out-turn No. 1 Sugar	Percentage	Cane crushed	Out-turn No. 1 Sugar	Percentage	Cane crushed	Out-turn No. 1 Sugar	Percentage
	Kantars	Kantars		Kantars	Kantars		Kantars	Kantars		Kantars	Kant.	
Dara Sameh .. .	14,478,546	1,230,373	8.5	13,680,914	1,253,725	9.2	14,515,565	1,559,353	9.4	11,859,185	1,161,171	9.08
Dara Sultan Pasha.	451,399	36,519	8.1	479,822	47,885	9.1	156,927	42,059	9.2	524,166	49,169	9.04
Société Générale des Sucreries de la Haute-Egypte..	5,098,826	404,431	8.0	6,250,320	604,002	9.6	5,978,871	575,199	9.6	6,908,772	682,587	9.88
Egyptian Sugar and Land Company.	—	—	—	516,355	49,638	9.8	501,336	46,608	9.2	850,500	81,810	9.06
Beni Korrah .. .	270,000	18,000	6.7	—	—	—	501,337	46,608	9.2	—	—	—
Total Kantars..	20,298,672	1,689,317	8.3	20,957,111	1,959,750	9.3	21,969,139	2,080,637	9.4	20,154,223	1,975,337	9.08

The following statement gives the areas under sugar-cane irrigated from the Ibrahimiyyah Canal in the different provinces during the past three years, and the area raised south of Asyut during the past year irrigated by wells and lifting machines on the river:—

YEAR.	Asyut	Minia.	Beni Suef	Fayum.	Total.	South of Asyut.	Grand Total.
1898	9,883	35,232	5,383	854	51,352	—	—
1899	9,473	33,829	7,082	677	51,061	—	—
1900	8,052	22,139	5,670	458	36,319	17,410	53,759

In Asyut, Minia and Beni Suef the areas are less than last year, and the average. The decrease under sugar is however nearly accounted for by the increased acreage under cotton doubtless brought about by the upward tendency in the cotton market at the beginning of the year. The areas under sugar south of Asyut have not been previously

\* 6,574,761 Cane,  
334,998 Bect-root.

recorded but it is advisable to do so as their out-turn also comes to the several factories. The bulk of the area shewn is irrigated by the Nag Hamadi Pumping Station.

The following statement gives the ares of Summer Durah or “Qedi”<sup>Sorghum or Summer Durah.</sup> grown in the basins of the different Provinces during the last two years.

YEAR.	AREAS IN FEDDANS IN THE DIFFERENT PROVINCES.							Total Area.
	Aswan.	Kenah.	Girga.	Asyut South.	Asyut North.	Minia.	Beni Suef.	
1900	2,972	24,258	39,261	12,389	7,701	3,890	6,076	96,547
1899	3,195	23,334	29,984	10,150	8,572	5,459	7,072	87,766

The increase in area over 1899 is 10% which in its turn exceeded the area of the previous year by 8%. Probably the large “Sharaki” area in the southern provinces forced the cultivators to turn their attention to “Qedi.” Why all the increase should be in Girga is not however easily explained. The out-turn of the “Qedi” was very good.

The Nabari area in the southern Provinces is estimated at 131,337<sup>Maize and Winter Crops.</sup> feddans. This is less than the 155,000 feddans reported last year, but still large. A low flood means large areas under Nabari. The out-turn was good.

The winter crops, particularly wheat, promise well. The severe rain-storm in January, 1901, damaged the bean crop but was of service to the wheat and berseem.

The total area of summer crops irrigated by the Ibrahimiyah Canal,<sup>Duty of water.</sup> according to the figures furnished by the Chief Engineers, is as follows:—

In the Asyut Province	...	...	...	...	...	...	...	23,267 feddans
.. Minia Province	...	...	...	...	...	...	...	62,343 ..
.. Beni Suef Province	...	...	...	...	...	...	...	33,782 ..
.. Fayoum Province	...	...	...	...	...	...	...	43,183 ..
Total								162,575 feddans

The mean discharge for the three summer months at the head of the canal, after deducting for escapage at Deirut, may be taken as 5,348,247 cubic metres, which on the above area gives a duty of 32·8.



The mean and minimum discharges recorded during the year in the Ibrahimiyah Canal and Bahr Yusuf are as follows:—

CANAL.	Site.	Mean discharge April to June.	Lowest recorded discharge.
Ibrahimiyah ... ..	Above Deirut... ..	4,484,160	3,012,768
—	Below Deirut... ..	2,343,168	1,496,448
—	.. Maghagha ... ..	752,680	694,656
Bahr Yusuf ... ..	.. Lahun... ..	1,373,949	799,574

Taking the areas in the different Provinces given above we obtain the duty of water in each group as follows:—

PROVINCE.	Duty on mean discharge	Duty on minimum recorded discharge.
	C. M.	C. M.
Assyut, Minia, Beni Suef and Fayum together. ... ..	26'60	18'0
Minia and Beni Suef together ... ..	24'40	15'5
Beni Suef alone ... ..	22'30	20'6
Fayum alone ... ..	31'80	18'5

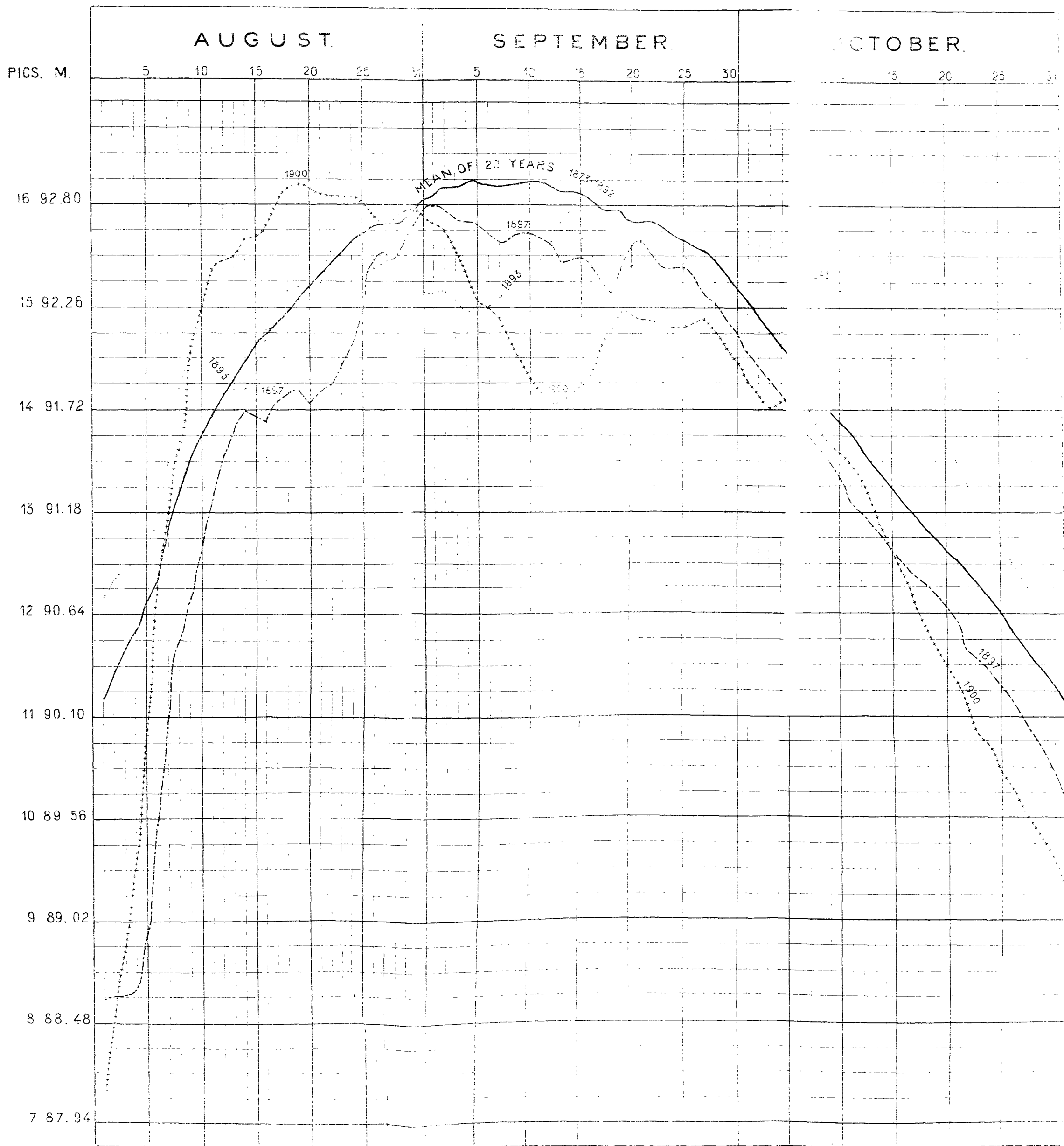
The duty has for some years past been calculated on the minimum recorded discharge at the various sites. The discharges are recorded at regular intervals and the minimum recorded discharge may agree closely with the true minimum one year, and largely exceed it the next. I can find no explanation for this practice, and the duty so arrived at does not appear to me to bear much meaning. Mr. Webb agrees with me that the duty should be calculated on the mean summer discharge. The results attained by the two methods are of course very dissimilar. One would naturally expect Beni Suef at the tail of the system to show a higher duty than Minia, and the Fayum with one watering in twelve days to show a much lower duty than the other Provinces with one watering in from nineteen to twenty-six days.

### SECTION III.—FLOOD IRRIGATION.

General  
character of  
the flood.

The accompanying diagram shows the Aswan gauges for 1900, for 1897, the year most in accordance with 1900, and for the twenty years ending 1892.

# G A U G E AT A S W A N.





The following statement of maximum and mean gauges at Aswan for 1897 and 1900 shews how closely the two years agreed:—

ASWAN GAUGE READINGS.	1897		1900	
	Gauge Reading.	Date.	Gauge Reading.	Date.
	P. K.		P. K.	
Maximum reading ... ..	16 0	Aug. 31st.	16 5	Aug. 19th.
Mean for 40 days ending 24th September.	15 6	—	15 7	—
Mean for irrigation south of Sohag, 11th August to 14th October.	15 1	—	15 3	—
Mean for irrigation north of Sohag from 10th August to 20th October. ... ..	14 18	—	14 9	—

The unfavourable features of the past flood, as compared with that of 1897, were the early occurrence of the maximum level, which was almost co-incident with the opening of many of the basins, and the consequent poor levels during September, which greatly retarded the filling of the basins. The Aswan gauge readings on the last day of each decade of September for the two years were as follows:—

DATE.	GAUGE READINGS.		DIFFERENCE.
	1897.	1900.	
	Pics. Kirats.	Pics. Kirats.	
September 10th ... ..	15 17	14 8	1 9
„ 20th ... ..	15 15	14 22	0 17
„ 30th ... ..	14 18	14 11	0 7

*In the 5th Circle.*—The following statement shews the dates on which water entered the Aswan isolated basins, and the two southern basins of the Ramadi system, the amount by which the maximum level attained in each basin fell short of T.R. Level, and the resultant “Sharaki” area. These basins are each fed direct from the river, and do not form a chain so farre badly in low floods:—

NAME OF BASIN.	Date on which water entered basin.	Amount by which maximum level fell short of T.R.L.	Sharaki area in feddans.
Hod El Khattara ... ..	August 6th.	0·97	200
„ Daraw ... ..	„ 7th.	0·77	150
„ Eghi ... ..	„ 7th.	1·18	80
„ Ramadi South ... ..	„ 11th.	1·35	600
„ Ramadi North ... ..	„ 11th.	0·84	200
„ El Redissiya ... ..	„ 11th.	0·81	280
„ Silwa ... ..	„ 11th.	0·70	550
Total... ..			2,060

Water entered the main feeder canals of the different systems between the 4th and 7th of August. In most cases all the available supply of the first few days was required for sugar-cane and Nabari, in others, such as the Shanhuriyah and Samata Canals, Ghilasi system, the heads were not fully opened till the 15th August. Basin feeders were generally opened between the 10th and 15th August and were all open by the 18th August, by which date the harvesting of "Qedi" dhurah had been completed. T.R. levels were reached, as a rule, between the 18th of September and the 30th October. The latest basins were those in the Shanhuriyah and Ghilasi systems, which were not completely filled till the 2nd and 6th November respectively.

The following points in connection with regulation are worth recording.

On the Ramadi Canal the Kilh Regulator, kilometre 38, was closed on 27th August to fill the Ramadi and Edfu basins, and the lower reach of the canal was fed through the old Nazariyah Head. This regulator was re-opened from 10th to 21st September and was left fully open from the 29th September onwards. The maximum U.S. level attained was 84.90. Meammariyah Regulator, kilometre 50, Ramadi Canal, was regulated on from 10th to 15th September to fill Hods El-Bassaliya, Sibaiyah and Namasa. Water was held up on Qariyah Regulator, Ramadi Canal, from 13th September for the benefit of Hods Esna South and North. The Dinigrat Regulator, Asfun Canal, was alternately opened and closed for the benefit of the northern Daira Samieh lands, and the southern basins and Daira Samieh sugar plantations. The Asfun and Um Adas Canals were saddled on 5th October, and the filling of the basins completed by Sarf from the Ramadi system. Water was held up on the regulator at kilometre 21 of the Killabiyah Canal from 28th August to 7th September, and again from 18th to 26th September, to try and fill Hod Hillah. Der but notwithstanding this the maximum level attained fell short of T.R.L. by 0.64. The Sharaki area in this basin was 300 feddans out of 1,800 feddans.

The Fadiliyah system calls for no special remark. Hods El Akhmas and Qamula were brought up to T.R.L. by Sarf from Hod Dabiya at the tail of the Asfun system.

Sabil Farshut and Bayadiyah systems call for no remark. Hods Qift, Shanhuriyah system, gave some trouble, but by isolating the southern corners by means of temporary banks, and filling the first from Hod Farrash, all Sharaki was avoided.

In the Ghilasi system the deep Hishah Basin did not reach T.R.L. till 13th November.

The Samhud Saliba Regulators were opened on 16th August, but closed again on the 19th August and not re-opened till 26th September. As noted in last year's Report Beni Himel West Basin cannot draw water through the Samhud Basin till the Damraniyah feeder canal has been extended to the Samhud Salibah. It is proposed to execute this useful work in 1901.

*In Girga Directorate.*—The main feeder canals were opened between the 4th and 12th August. The two last canals to commence working were the Mahgar Haridi, Khizindariyah system, and the Maabda Canal, Abnub system. Water was admitted to all the basins between the 10th and 15th August. T.R. levels were all reached between 24th September and 19th October. The maximum time taken in filling a basin was sixty-nine and the minimum sixteen days. The Nile Escapes were used as much as possible as feeders.

The following are the points of interest:—

In the Khiyam system the effect of the Hammam bank, made in 1899, was to reduce the T.R. level of the main portion of Hod Mazata by 0·38, a useful gain. In the Akhmim system and basin of the same name there was an area of 140 feddans Sharaki. All the water of this system was passed on to the Khizindariyah system through the Isawiyah Canal.

In the South Sohag System the basins dependent on the Rashwaniyah Canal did not reach T.R.L. till 14th October. The Director of Works attributes this to the opening of the Samhud Escape to feed the Samhud Basin between 16th and 19th August, which he considers was a bit of poaching on the part of the Inspector, 5th Circle. The latter does not admit the accuracy of this statement, asserting that the Samhud Basin is too high to draw anything worth having through the Escape.

In North Sohag system Hod Kom Badr West was brought up to T.R.L. by creating an artificial wave in the Sohagiyah Canal. The R.L. attained was 58·06 which left an area of only 60 feddans Sharaki in the Hod. The construction of the Tahlibat Regulator will render this and the neighbouring Hods safe for the future. The filling of South Asyut, Khizindariyah and Abnub basins calls for no remark.

The Gebel Asyut Regulator was kept fully open from the beginning of the flood till the 20th September, when regulation on it commenced and continued up to 8th October, when the regulator was finally closed for Sarf. The cills of this regulator were removed in 1897 and the water-way through the Mallah Salibah was largely increased

by incorporating the Mahgar Mangabad Regulator, which used to act as a feeder from the Ibrahimiyah Canal, in it. These alterations cause the Sohagiyah Canal to send a much larger volume of water northwards to the Asyut basins than it did before their execution.

*In the 4th Circle.*—In Asyut and Minia Provinces all basins were opened between 10th and 18th August, and in Beni Suef Province between the 7th and 10th August. The various systems reached their T.R. levels on the dates given in the following statement:—

NAML OF SY-TEM.	Date on which T.R.L. was reached.	Remarks
Asyut-Delgawi ... ..	25th Sep. to 1st week Oct.	Some of the basins were takh-fied.
East Ibrahimiyah above Deirut.	Middle of October.	Except Walidiyah Beni Hussein which failed to reach T.R.L.
East of Yusufi, Asyut ...	1st week September.	Hod Itqa was brought to T.R.L. during Sarf.
Sabakhah ... ..	25th September.	Takhfied.
Etsam ... ..	30th September.	Hod Dori was brought to T.R.L. during Sarf.
Abu Bagara ... ..	20th to 26th October.	Filling delayed owing to accident to Abu Bagara Syphon.
West Yusufi South group	12th to 20th October.	T.R.L. produced by wave in Yusufi.
Do. North group	15th to 21st October.	
Beni Suef Basins ... ..	26th to 30th October.	T.R.L. produced by Sarf.

The following points in connection with filling these basins are worthy of record.

The feeder-heads from the Ibrahimiyah Canal to the Asyut-Delgawi basins were all closed, except the Hod Delgawi feeder, on 1st September. The latter was closed on the 2nd October. Hods Tanuf, Tanda, Ashmunin and Itqa were filled for the last time as their conversion into Sefi tracts commences with 1901.

The West Yusufi Basins were only completed just before the flood. The southern and northern systems are to be filled by means of the new regulators Nazlet El Abid and Saqulah respectively. The Nazlet El Abid regulator was completed before the flood, but, owing to the failure of the lifting winch, regulation on it could not be made till an advanced date. The Saqulah Regulator was not completed before the flood. Hence the old system, described in previous reports, of creating a wave in the Yusufi, by the simultaneous discharge of the South

Minia basins and the Asyut-Delgawi system, was resorted to. Regulation commenced on Nazlet El Abid Regulator on 29th September, but the regulator had to be fully opened on 9th October to allow the wave to pass. On 15th October regulation was resumed, and Hod Tukh, one of the two southern basins of the south group, was brought up to T.R.L., the other southern basin had reached T.R.L. a few days previously. These two south basins were then used to fill the two northern basins of the group.

The new regulator and the Sabaah Regulator, in the Kosheshah Saliba, were kept fully open as long as water was being drawn through the Koshesha Escape, from the river, in order to pass red water into Hod Riqqa. The usual rule, that Komi Regulator in Salibah Riqqa should remain open as long as the Kosheshah Escape was open, was not followed as the Girza Canal was working freely. The Komi Regulator was opened from 19th to 21st August, Hod Maarkab being then higher than Hod Riqqa. From 26th September to 13th October Komi Regulator was partially opened for the benefit of the Gizah Nabari crops, the downstream level being maintained at 23.75. Between 13th and 17th October, Komi was gradually closed to bring Hod Riqqa to T.R.L. On 27th October Komi was fully opened.

*In the 5th Circle.*—The following statement gives the dates of commencement and completion of the Sarf operations in the different systems and the dates on which the Nile Escapes were fully opened:—

SARF OPERATIONS IN 5TH CIRCLE.

NAME OF SYSTEM	Date of commencement of "Sarf."	Date of completion of "Sarf."	Date on which Nile Escapes were opened
Ramadi ... ..	5th October.	15th October.	16th & 18th Oct.
Asfun ... ..	10th October.	13th October.	16th & 17th Oct.
Killabiyah ... ..	2nd October.	3rd October.	25th October.
Fadiliyah ... ..	13th October.	29th October.	23rd & 29th Oct.
Sahil Farshut ... ..	11th October.	23rd October.	18th October.
Bayyadiyah ... ..	5th October.	16th October.	29th October.
Shanhuriyah ... ..	19th October.	3rd November.	6th November.
Ghilasi ... ..	11th Oct. & 14th Nov.	8th & 17th Nov.	14th November.

The following points are worthy of record:—

In the Asfun system the saddle at the head of Um Adas Canal, made on the 5th October, was cut on 16th October. On the Killabiyah system the Nile Escape was not opened till 25th October, all



the water being passed on to the Bayyadiyah system. On the general completion of Sarf in the Sahil Farshut system Sarf water from Hods Marshda, Wakf and Hew was passed down the eastern branch of Raunan Canal for Sugar and Nabari crops. Damraniyah Canal was saddled at its head and tail to keep water on the Raunan Canal syphon. In the Bayadiyah system the Bayadiyah Canal Head was saddled with stone: all the Sarf water being required for the Shanhuriyah system. Hod El Ashshi Escape was not opened till 29th October. In Shanhuriyah system the Gabalaw Saliba Regulator was opened for the benefit of the Ghilasi system four days before Gabalaw Nile Escape was fully opened. In the Ghilasi system the Sarf was late, owing to the measures taken for irrigating the Sahels of Hod El Samata, and the necessity of passing on water from Hod Hamad to fill Hod Hisha. During the latter operation care was taken to make sadds up and downstream of the syphon under the Taref Canal, through which the Hamad water passed. Hamad Escape was opened on 14th November and collapsed on 17th idem.

*In the Girga Directorate.*—The following statement gives the dates of commencement and completion of Sarf in the various systems, and opening of Nile Escapes:—

SARF OPERATIONS. GIRGA DIRECTORATE.

NAME OF SYSTEM	Date of commencement of Sarf.	Date of completion of Sarf	Dates on which Nile Escapes were opened
Khiyam System...	8th to 17th October.	14th Oct. to 3rd Nov.	11th & 17th Oct.
Akhmin ... ..	8th to 17th October.	19th to 22nd Oct.	17th Oct.
South Sohag. ...	5th to 18th October.	19th Oct. to 7th Nov.	17th to 30th Oct.
North Sohag. ...	2nd to 22nd October.	16th Oct. to 7th Nov.	17th Oct.
South Asyut. ...	6th to 17th October.	20th Oct. to 6th Nov.	17th Oct.
Khizindaryah ...	5th to 17th October.	14th to 27th Oct.	17th Oct.
Abnub ... ..	5th to 17th October.	19th to 24th Oct.	17th & 18th. Oct.

The Sarf operations call for no special remark.

*In the 4th Circle.*—The dates of commencement and completion of Sarf in the several provinces were as follows:—

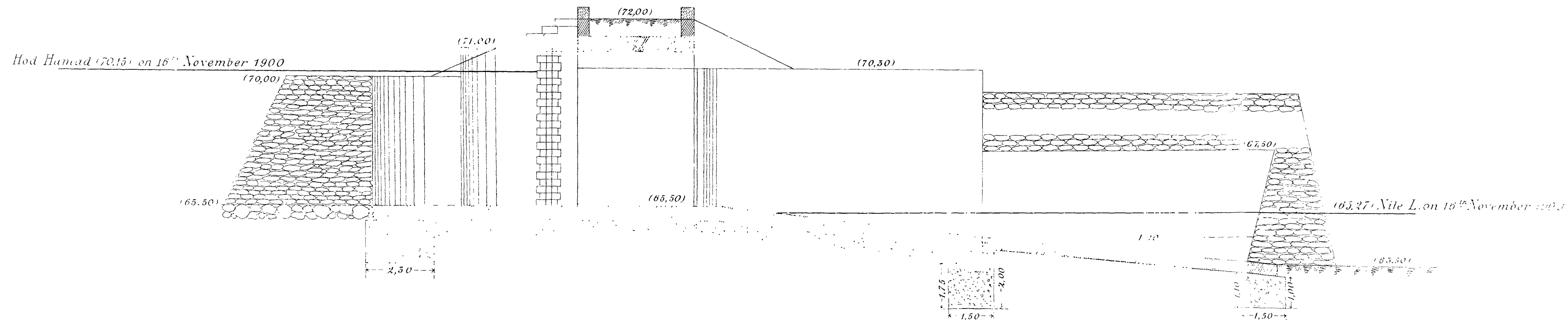
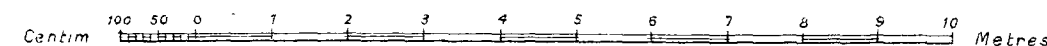
PROVINCE.	Sarf commenced	Sarf completed.	Remarks
Asyut ... ..	Oct. 5th.	Oct. 31st.	Low portions of Hod Belgawi not uncovered till middle of November
Minia ... ..	15th to 20th Oct.	8th to 16th Nov.	
Beni Suef ... ..	26th to 31st Oct.	21st Nov.	



# OLD ESCAPE HAMAD

5<sup>th</sup> Circle of Irrigation

Scale  $\frac{1}{100}$



Altitudes in Metres above Sea Level . 70.30.

Appendix L gives the dates of the principal events of Sarf in the 4th Circle during 1896, 1897, 1898 and 1900. 1899 being quite an exceptional year is not included. Hods Walidiyah and Beni Hussein were Sarfed on to the Nile Sahels and Hods Manfalut, which were thus brought up to T.R.L. The late date of opening Kosheshah E-scape is a point requiring explanation. This was due to the following causes. The Yusufi channel, having been confined by the construction of the new basin tarrads on its west bank, the Minia basins on the east bank could not be discharged as rapidly as usual. Secondly, the west Yusufi Basins were late in reaching their I.R. levels owing to the Nazlet El Abid and Saqulah Regulators not being completed, and the fact that the Sarf wave in the Yusufi, instead of spreading over them unchecked, had to be passed through the feeder-heads and Salibah regulators. Thirdly, the volume of the Sarf wave in the Yusufi being smaller than usual took longer to reach the Beni Suef Basins. With the regulators serving the west Yusufi system complete, and Mazurah Regulator to hold up water for the Beni Suef Basins also complete, the delay above noted is unlikely to occur again.

The low river-levels at time of Sarf tested the masonry works severely. The Hamad Escape at the tail of the Ghilasi system, a work of five 3-metre vents, was opened on the 14th November, and collapsed on the night of the 16th, and the railway bridge immediately upstream of it followed shortly afterwards. The accompanying section shews the state of affairs as regards levels on the date of the accident. As the accident happened at night, and no responsible officer was on the spot, it is impossible to ascertain the immediate cause. Seeing the severe head under which the Escape was working, it is not improbable that it blew up. Ramzi Eff., Chief Engineer of Kena, was dismissed from Government service in connection with this failure. He had disobeyed his Inspector's distinct and reiterated orders to remain on the spot, and take frequent soundings below the Escape. There were a few small canal breaches of no importance, in the 5th Circle. On the 12th September the upstream west wing-wall of Qolosna Aqueduct, carrying the Ibrahimiyah Canal over the Abu Bagara Canal, split off from the body of the work, and let the Ibrahimiyah spill into the Abu Bagara. The supply of the Abu Bagara had to be stopped and that of the Ibrahimiyah cut off for a few days. The accident had no appreciable effect on the irrigation of the dependent basins, which had been almost completed at the time of its occurrence. The Hatabah Bridge, Delgawi Salibah, shewed signs of failure after

Accidents  
during the  
flood.

the commencement of Sarf. There were breaches in the Saliba of Qanadir and the Tarrad of Hod Kom Edrigah, in each case after commencement of Sarf.

New Works  
shewn to be  
necessary by  
recent flood  
seasons.

The following statement shows the works considered necessary by the Inspectors of Irrigation for the improvement of flood irrigation :—

Serial Number.	Circle.	Province or System.	DESCRIPTION OF WORK
1	5th Circle	Aswan ... ..	Lowering bed of Debeirah Canal 0'50.
2	"	" ... ..	Making a new canal at Eneiba, Korosko.
3	"	" ... ..	Lowering beds of Sayalahs El Khattarah, Eglit Daraw, Bimban to 10 cubits.
4	"	" ... ..	New Sayalah for Gheziret Baharif.
5	"	" ... ..	New Faris Canal south of Shellal.
6	"	Ramadi system ...	Prolongation of Sayalah Sa hel El Ramadi to Sahel Edfu.
7	"	" .. ..	Prolongation of Sayyalah Hod El Bassaliya West to Hod El Sibaiyah.
8	"	" .. ..	New Regulator for above in Salibah Basaliyah.
9	"	" .. ..	Regulator in Salibah Hod Edfu and remaking old Sayalah through Hod El Bassaliyah.
10	"	" .. ..	Prolongation of Sayyalah El Adayma Hod El Namasa to join Sayalah Kommer.
11	"	" .. ..	Prolongation of Sayalet Sahel El Adayma to join Sayalah Sahil El Namasa and prolongation of the latter to join Sayalah El Ghoreirah.
12	"	" .. ..	Head Regulator for Sayalah El Namasa.
13	"	" .. ..	" " " El Ghoreira.
14	"	" .. ..	Widening Sayalah El Ghoreira to 3 metres.
15	"	" .. ..	Prolongation of Sayalah Hod Esna South to Salibah.
16	"	" .. ..	Prolongation of Sayalah Sahil Esna to the Mawati and the new Escape.
17	"	" .. ..	Feeder Culvert for Sahil El Nigoos.
18	"	Asfun .. ..	Canal along west of Asfun Canal from Mawati of Hod El Kiman to join Sayalah Hod El Mahamid, and thus connect Ramadi and Asfun systems.

Serial Number.	Circle.	Province or System.	DESCRIPTION OF WORK
19	5th Circle	Killabiya system...	Bank round southern portion of Sahil Hod El Salamiyah North to admit of its being flooded from the branch of the Killabiyah which syphons under the Mealla Canal.
20	"	" " ...	Culvert in left bank of Sayalah Sahel Hod El Sallamiya North to irrigate Sahel.
21	"	" " ...	2-span Regulator at tail bifurcation of Killabiya Canal.
22	"	" " ...	Prolongation to Mawati of Sayyalah Hod Hilla Der
23	"	Ghilasi " ...	Extension of Ghilasi Canal southwards thro' existing khors to improve its head discharge.
24	"	" " ...	Red water feeder for Hod Hisha
25	Girga Dir.	Khiyam " ...	Regulator in new Hammam bank to pass water from Hammam North basin to Hod Mazata.
26	Girga Dir.	Khiyam " ...	Culvert in Hammam new bank on Gebel Sayalah to pass water from Hammam east basin to Hod Mazata.
27	"	" " ...	Culvert in the Nile Tarrad of Hoslah Awlad Khalaf for irrigation of Awlad Khalaf Sahil.
28	"	Akmim " ...	Head Regulator for Shanshifi Sayalah on right bank of Isawiyah Canal.
29	"	" " ...	Culvert in same bank at head of northern borrow-pit of Hosha Nag Sawamāa Salibah to feed Saculta Basin.
30	"	" " ...	Culvert for Head of Akhmim to Sayalah.
31	"	" " ...	Culvert for Hawawish Sayyalah in Akhmim south bank.
32	"	South Sohag ...	Division of Hod Bardis East.
33	"	" ...	New channel taking off upstream of Abu Shusha Regulator, Rashwanayah Canal and syphoned under Kasra Canal to feed Um Tubul Canal for irrigation of Sahils Baliana and Bardis.
34	"	" ...	Feeder for Hod Bayadi from Um Tubul Canal.
35	"	" ...	Culvert and discharge channel in Beni Himel East Salibah to feed Hod Bardis East.
36	"	" ...	Head Regulator for Barkheil Sayyalah Kasrah Canal.

Serial Number.	Circle	Province or System	DESCRIPTION OF WORK
37	Girga Dir.	South Sohag ...	Head Regulator for Girgawiyah Canal.
38	"	" ...	Head Regulator for Hakim Sayalah Sohag East Basin.
39	"	North Sohag ...	Supplementary syphon under Tahtawiyah for Qiffaw Canal.
40	"	" ...	Culvert in Nile Tarrad of Hod Mortin for irrigation of Sahil Gheziret El Qaramta and Shandawil.
41	"	" ...	Culvert to feed southern borrow-pit of Enobis Salibah in east and west banks of Tahtawiyah Canal.
42	"	" ...	Head Regulator for Sayalah Wadea.
43	"	" ...	Culvert for Hod Beni Hilal Sayalah in Baroud bank.
44	"	" ...	Regulator on Qaw Canal Salibah Sabaika.
45	"	" ...	Culvert up-stream of above regulator to feed Sabaika and Sahil Mishra borrow-pits.
46	"	" ...	A culvert in Nile Tarrad of Hosha Tina to replace cut for "Sarf."
47	"	Abnub system ...	Culvert in Nile Tarrad of Hosha Shagilqil for sarf of that Hosha and Hod Beni Mohammed.
48	"	" ...	Head Regulator for Maabda Canal.
49	4th Circle	Asyut ...	Syphon under Ibrahimiyah Canal to irrigate basins between Railway and the Nile from Asyut to Nazali, from Hod Mallah.
50	4th Circle	Beni Suef ...	Syphon under Magnuna Canal to carry water from Ibrahimiyah Canal to the basins east of the Railway and north of Ashmant.

The list is a pretty long one, the Inspector of Irrigation, 5th Circle, being especially prolific in suggesting new works. There is no doubt that the majority of the proposals are sound. Most of the works proposed are petty. Great results are often reaped from these minor improvements such as extension of a channel or giving an extra supply at a better level to a Sahil or Hosha by building a new culvert. Items 5, 6, 7, 9, 21, 22, 25, 26, 35, 37, 43, 44, 45, 48, 49, 50 will probably be executed in 1901.

An expenditure of £E.3,440,250 was incurred in making temporary banks on Sahils and Ghezirahs and cutting off high portions of Hods to prevent "Sharaki." The following statement shews how the expenditure was divided between the circles and the work executed:—

CIRCLE.	EARTHWORK EXECUTED		Expenditure on sundries	Total Expenditure
	Cube	Cost.		
	CU.	£L.	£L.	£L.
5th Circle ... ..	43,992	590,250	—	590,250
Girga Directorate ...	—	—	—	—
4th Circle ... ..	263,811	2638,110	311,890	2950,000
Totals... ..	307,803	3228,360	311,890	3540,250

The Sharaki areas were as follows:—

PROVINCE.	SHARAKI AREAS.		TOTAL
	Hods	River Sahils and Islands.	
Aswan ... ..	2,060	3,777	5,837
Kena ... ..	300	2,082	2,382
Girga ... ..	200	1,000	1,200
Asyut ... ..	900	2,212	3,112
Minia ... ..	—	2,000	2,000
Beni Suef ... ..	205	1,725	1,900
Totals... ..	3,665	12,796	16,461

Part of the total area unflooded has since been irrigated by lift. The corresponding figure for 1897 was 12,730 feddans. The difference of 3,731 feddans is not more than might reasonably be expected, in view of the Aswan Gauge readings during September in each year, which have been compared in a preceding paragraph.

#### SECTION IV.—FLOOD WATCHMEN.

The total number of men called out was 28,738. The average Nile Corvée number of days they remained out was 41. The total number of days' labour was 1,177,545. The number of days' labour in 1897 was 848,490. The reason of the difference is to be found in the high levels at the beginning of August when, as before remarked, there was every expectation of a high flood. The next low year suitable for comparison is 1893 when the total number of days labour in Upper Egypt was 2,125,000. The long length of new banks in the West



Yusufi Basin system is also largely responsible for the higher figure as compared with 1897. The distribution of the flood watchmen in the different circles is shown in the following statement :—

Circle and Province	Nile Banks				Basin Banks				Canal Banks				Branches				Disturb.		Totals	
	Number of men called out	Average number of days out	Length of banks in kilometers	Average number of men per kilometer	Number of men called out	Average number of days out	Length of banks in kilometers	Average number of men per kilometer	Number of men called out	Average number of days out	Length of banks in kilometers	Average number of men per kilometer	Number of men called out	Average number of days out	Number of bridges	Average number of men per bridge	Number of men called out	Average number of days out	Number of men called out	Average number of days out
1st Circle	—	11	85	2	210	60	11	15	320	100	68	5	65	101	1	1	100	60	595	52
	111	30	163	11	2233	30	163	11	102	62	86	1	117	30	—	—	3013	60	3013	50
	1052	11	121	11	1121	11	123	10	186	26	116	1	110	62	—	—	9072	3	9072	50
	707	17	136	5	2046	50	285	10	82	45	201	1	158	67	—	—	1939	—	1939	—
Total	1300	—	422	1	9833	—	88	11	1136	—	171	3	750	1	—	—	3700	9	17619	37
GIZA PROVINCE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	520	5	117	1	115	35	101	1	170	51	109	2	217	63	86	3	20	50	1375	51
	888	35	231	1	1972	17	200	5	222	31	534	1	551	63	201	3	70	12	5709	18
Total	1408	—	348	1	2390	—	391	6	2398	—	613	1	768	—	287	3	90	11	7081	51
5th Circle	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	654	38	204	2	1535	50	575	3	635	50	303	2	782	16	205	3	337	35	3013	16
	14	11	9	1	11	11	9	1	61	63	19	—	61	63	19	—	—	—	42	56
Total	668	—	303	2	1549	—	585	3	635	—	306	2	846	—	221	3	337	35	1035	16
Grand Totals	3076	—	1163	31	13772	—	1861	7	1169	—	1123	3	2301	1	—	—	1127	12	28738	11

# SECTION V.—DRAINAGE.

No new drains were made during the year. The Daira Sanieh Middle Egypt Administration has a few small projects for drains in the Minia Province in hand.

The conditions regarding drainage have been somewhat altered during the year by the completion of the Nazlet El Abid and Saqulah Regulators on the Bahr Yusuf, below which drainage water, during flood, can be dropped into the latter channel. The Mazurah Regulator and Lock on the Bahr Yusuf, to be completed during 1901, will also effect a marked alteration on the conditions of drainage during flood. With this regulator completed, and an extension of the main Muhit Drain, to be carried out as one of the "Special Works" in 1901, a certain amount of the drainage water of the Asyut and Minia Provinces can be passed into the Bahr Yusuf, even in flood. Another item included in "Special Works" for 1901 is the Etsa Pumping Station which will, during flood, raise and pass to the river water from the upper section of the main Muhit Drain, serving portions of the Sefi areas west of the Ibrahimiyah Canal in the Asyut and Minia Provinces. Projects for other pumping stations are also under consideration.

In the clearance of drains a cube of 270,147 metres cube was executed at a cost of £E.3266,630.

A start with re-modelling and extending the drainage systems of Fayum the Fayum was made during the year by remodelling Masraf Abu Awad in the Tagin system at a cost of £E.3916,500 mill. chargeable to the Special Caisse Credit. The following table gives the levels of Lake Qarun on 1st March, for the past seventeen years:—

YEAR	Level of lake in metres below sea-level	Fall in previous 12 months	YEAR.	Level of lake in metres below sea-level	Fall in previous 12 months
1885	39.89	Unknown.	1894	43.84	0.06
1886	40.00	0.20	1895	44.17	0.33
1887	40.38	0.38	1896	44.16	0.01 rise.
1888	40.73	0.35	1897	44.27	0.11 fall.
1889	41.17	0.44	1898	44.32	0.05 "
1890	42.00	0.83	1899	44.25	0.07 rise.
1891	42.78	0.78	1900	44.10	0.15 "
1892	43.32	0.54	1901	43.90	0.20 "
1893	43.78	0.46			

The total fall during the past sixteen years has been 4.10 of which 1.37 took place during the first ten giving an average of 0.137 per annum. During the past six years there has been a net rise of 0.27,

## Part. II.—SPECIAL WORKS.

*(Chargeable to Special Caisse Credit and to Special Grant from Ordinary Budget.)*

The sum available for expenditure on special works during the year was £E.143,750, made up as follows:—

Special Caisse Credit	...	...	...	...	...	...	...	...	£E.
Special Grant from Ordinary Budget	...	...	...	...	...	...	...	...	120,000
									23,750
Total	...	...	...	...	...	...	...	...	143,750

Appendix F gives a general abstract showing the partition of the expenditure on the several projects. Appendices G and H give lists of the various masonry works, the new channels and banks constructed, and the existing channels remodelled during the year. The projects taken in hand or advanced during the year were the following:—

West of Yusuf Basins,  
Mazurah Lock and Regulator,  
Fayum remodelling Works,  
Conversion of Basins into Perennial Irrigation in Asyut, Minia and Beni Suef Provinces.

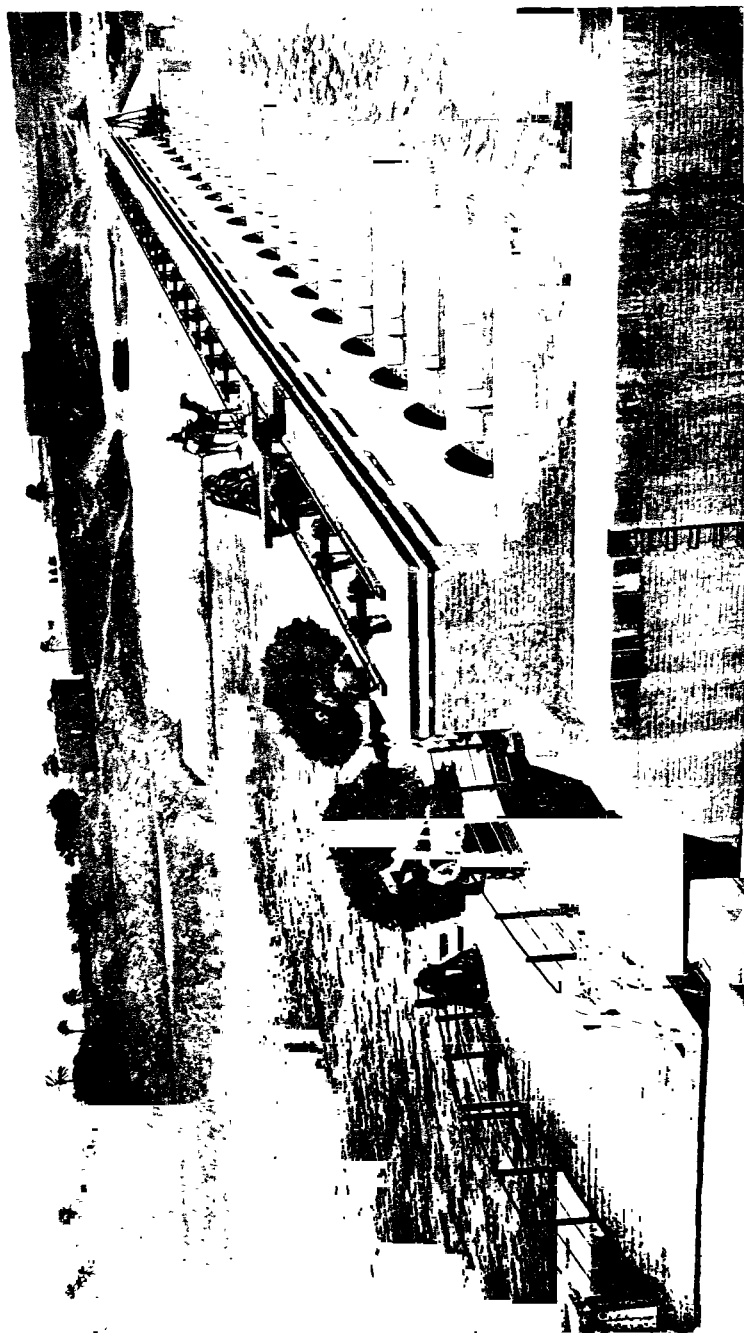
West of Yusuf  
Project.

Work on this project was commenced in 1899 and considerable progress made, the expenditure incurred having been £E.72,813. The year started with the super-structure of the big Nazlet El Abid Regulator and Lock, Bahr Yusuf, well in hand. The work on Saqula Regulator and Lock had been started in 1899, but had only reached the preliminary stages at the close of the year. Most of the minor masonry works, such as heads of feeder canals, regulators and escapes, had been completed in 1899, and 41 kilometres of new banks and channels had been made.

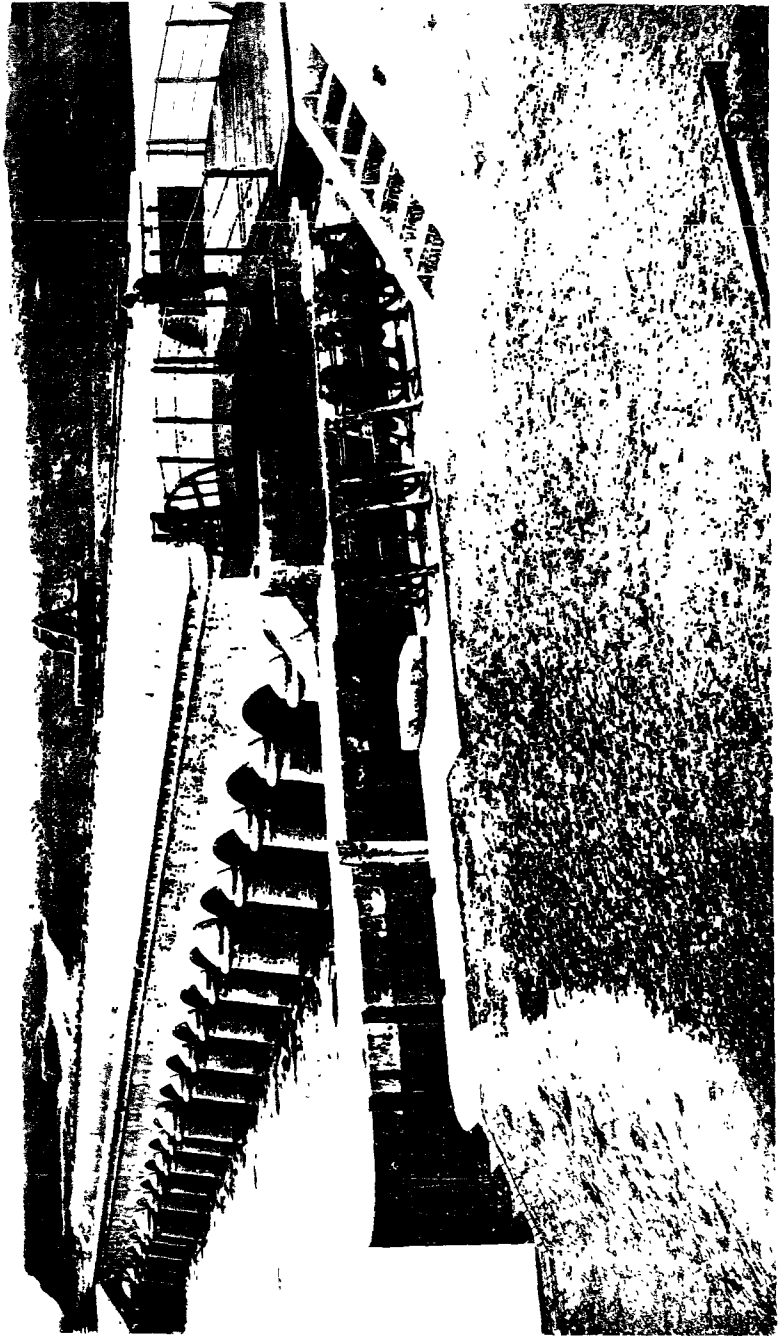
During the year estimates were sanctioned for the following works:—

1. Completing Nazlet El Abid Regulator and Lock.
2. Completing Saqula Regulator and Lock.
3. Three culverts in Salibahs Nazlet El Abid and Delhanis.
4. Seven Stores for Regulating Timbers.
5. Iron Pipe Feeders to Seti Hoshahs.
6. Payment for Delhanes Inspection House, constructed in 1899.
7. Construction of Salibahs Nazlet El Abid, Saqula and El Sab.
8. Completion of the Tarrads in Hods Tukh, Sushah and Qamadin, southern system, and Hods Bortobat, Qayat, Harigah, Shenarah and Delhanes in the northern system.
9. Construction of Hoshah Banks Hods Bortobat and Qayat.
10. Canals Zawiet Harim, El Sab and Kafr El Salihin.
11. Escape channels for Hods Shenarah and Delhanes.
12. Feeder channels in Hods Qamadin, Tirfa and El Der.
13. Collection of stone for revetment of Salibah Banks.
14. Purchase of land.





NAZALET-EL-ABID, REGULATOR AND LOCK, MINIA, 1899 1900



NAZARET-EL-ABID, REGULATOR AND LOCK, MINIA, 1899, 1900



All the above works were put in hand and practically completed during the year. The total expenditure incurred on the project during the year was £E.84,126,390, and the total expenditure up to the end of the year was £E.156,939,390. In the general five-year programme drawn up in 1898 a sum of £E.200,000 was put down for this project. It appears probable that it will be possible to work pretty closely to that forecast.

The Nazlet El Abid regulator and lock was practically completed before the flood. The masonry of the Saqula regulator and lock was also completed. The diversion of the Yusufi, on which the work is built, remains to be done in 1900 as well as the erection of the iron-work. The minor masonry works enumerated in Appendix G were all completed. One small escape is still required, and it seems not improbable that an auxiliary feeder head in Nazlet El Abid Salibah for Hod Tukh may be required. 120 kilometres of Salibahs Tarrads and new channels were carried out during the year, involving the handsome aggregate cube of 2,661,491 cubic metres earthwork. Collection of stone for the revetment of the north slopes of salibahs was commenced. A sum of £E.5,538,883 was spent in payments for land taken up for the new works.

The new basins were all satisfactorily filled during the flood, and the flooding of the Sahils of the Yusufi was also easily accomplished, a fact concerning which their proprietors had expressed apprehension when the project was started.

This work is being constructed on the Bahr Yusuf near the southern boundary of the Beni Suef Province. Its objects are clearly described by Mr. Clowes as follows:—

Mazurah  
Regulator and  
Lock.

1. To improve the irrigation of the Sultani, Minia and Nuerah Basins the aggregate area of which is 72,000 feddans.
2. To afford a means of disposing of a part of the drainage water of the sefi area of Minia Province, during flood time, by putting a rotation on the regulator and discharging the drainage water into the Yusufi below it.
3. To supplement the flood supply of the future perennial canals required for the conversion of the Beni Suef Basins.

An estimate for £E.45,000 was sanctioned for the work and an expenditure of £E.23,868,159 incurred during the year. The foundation and floor were completed before the flood, and good progress was subsequently made with the super-structure. Great credit is due to Mr. A. G. Sachs, the capable and energetic engineer in charge of this work as well as the Nazlet El Abid and Saqula Regulators and Locks.



Favum  
Remodelling  
Works.

These works are put down in the general programme of 1898 as likely to cost £E.126,000. The principal item of work undertaken during the year was the remodelling of the Bahr Nezzah and its branches, a channel which will ultimately command an area of some 56,000 feddans. A length of 17.6 kilometres of the main channel was remodelled during the year, the bed-width being increased from 7 or 8 to 15 metres. A small amount of rock-cutting remains to be done in this length in which the heavy cube of 454,271 cubic metres was executed during the year. One road-bridge and three head-sluices for branch canals were built; also a syphon for the Abu Awad drain. A commencement was made with the construction of Bahr Kasr Banat, a high-level branch of the Bahr Nezzah to command 18,000 feddans. A length of 30 kilometres of new channel was completed during the year. The cube of earthwork executed was 438,000 cubic metres, including 20,000 cubic metres rock-cutting. Seven head-sluices, one regulator and a syphon for the Abu Awad Drain were built. Bahr Abu Gandir, another branch of the Bahr Nezzah, was provided with a head-sluice and three small nasbahs.

A start was made with the remodelling of the Tagin Drainage System which serves the tract irrigated by the Bahr Gharaq, now badly water-logged. During the year the main drain and a couple of its more important branches were enlarged, and several minor channels made. The cube of earthwork executed was 153,877 cubic metres. Mr. Clowes notes that even with the small amount of work done there was a marked improvement indicated during flood-time.

In connection with the remodelling of this drainage system it was found necessary to divert the Bahr Lahf, a branch of the Bahr Gharaq, which was done. Another project started during the year was that for transferring the area, at present irrigated by Bahr Metartaris, a branch of the Bahr Tanhalla, to Bahrs Alan and Edwah, as it is necessary to maintain an injuriously high level in Bahr Tanhalla to force water into Bahr Metartaris. A new drain will be made dividing the areas irrigated by the Bahrs Alan and El Edwah.

Conversion of  
Basins in  
Asyut, Minia  
and Beni Suef.

The basins to be converted into perennial irrigation are divided into three groups, viz., the Asyut, Minia and Beni Suef, each of which forms a separate project. The remodelling of the Ibrahimiya Canal forms a fourth project. The progress with the preparation of the several projects up to the end of the year has been as follows:—

*Conversion of Asyut Basins.*—This project comprises the basins situated between the Bahr Yusuf and Deirutiya Canals extending

from Deirut to the northern boundary of Asyut Province. The aggregate area is 52,665 feddans. Survey started in 1898, and early in 1900 the complete project with detailed estimates was submitted and approved. Work started at the beginning of 1901, during which it is proposed to spend a sum of £E.110,000. The following are the principal items of work included in the project

Canals ... ..	243 kilometres.
Drains ... ..	139 „
Works ... ..	230 number.

*Conversion of Minia Basin.*—This project deals with the basins in Minia Province between the Bahr Yusuf and Muhit Bank, and extending from the southern boundary of Minia Province down to Salibah Salauks. The aggregate area is 113,000 feddans. Survey commenced in 1898 and the project was submitted, in its general lines, in 1900 and approved. The detailed estimates will be got out during 1901. By the end of 1900 the centre lines of the following lengths of channel had been laid down on the ground:—

Canals... ..	329 kilometres.
Drains... ..	243 „
Total ... ..	572 kilometres.

*Conversion of Beni Suef Basins.*—This project deals with the basins situated between the Bahr Yusef and Muhit Fasil Bank, from the southern boundary of Beni Suef Province to Salibah Bahabshin. The aggregate area is 94,000 feddans. Survey was started in 1899 and the general lines of the project have been approved of.

*Enlarging Ibrahimiyah Canal.*—The main feeder for all the basin land to be converted into perennial irrigation is the Ibrahimiyah, which requires considerable enlargement to pass the summer supply required. Cross sections of the channel from Minia to Sharahnah were taken in 1898 and a detailed estimate for the work submitted in 1900. It is proposed to spend £E.30,000 during 1901.

Besides the above items cross sections of a length of 310 kilometres of the Muhit Fasil and central Muhit drains were taken during 1900.

Ismail Bey Sirri and his staff are to be congratulated on the out-turn of work. The expenditure on establishment and petty items during the year was £E.3,500.

## Part III.—WORKS AND ESTABLISHMENT.

### SECTION I.—MAINTENANCE AND REPAIRS.

Details of the quantity of earthwork executed during the year and its cost are given in Appendix D. The total quantities are as follows :—

CIRCLE.	By Hand.		Dredging.	
	Quantity.	Cost.	Quantity.	Cost.
	CM.	£L.	CM.	£L.
4th Circle ... ..	4,817,579	58,303	268,581	10,555
5th Circle ... ..	2,549,663	31,757	—	—
Girga Directorate ...	2,195,319	26,492	—	—
Totals... ..	9,562,561	119,552	268,581	10,555

The total cube of earthwork by hand is considerably below the normal, all the saving being in the 4th Circle. The reduction of cube is due to the low flood of 1899 and consequent reduction in silt deposit. Advantage is generally taken of such reduced deposit in the upper reaches of canals to clear reaches long perforce neglected, which is the reason that the cubes in the 5th Circle and Girga Directorate are normal. The 4th Circle had a pretty heavy dredging bill to meet which consumed its savings on general earthwork. The average cost per cubic metre of earthwork by hand was as follows:—

	P.T.
4th Circle ... ..	1·21
Girga Directorate ... ..	1·20
5th Circle ... ..	1·32

These rates are slightly below the normal, from which fact it would appear that the large quantity of work now being executed in both Upper and Lower Egypt has no appreciable effect on the supply of labour.

The following table shews the quantities dredged in the Ibrahimiyah Canal during the last ten years:—

Dredging the Ibrahimiyah Canal.

YEAR.	QUANTITY IN CUBIC METRES.			COST IN £E.
	Asyut to Deirut.	In the River at Asyut	Total.	
1891	836,116	—	836,116	30,591
1892	413,088	—	413,088	15,597
1893	371,926	—	371,926	14,400
1894	448,026	—	448,026	16,888
1895	351,253	—	351,253	13,225
1896	300,706	—	300,706	11,347
1897	214,212	—	214,212	8,196
1898	247,813	—	247,813	9,374
1899	129,367	—	129,367	4,872
1900	201,656	66,925	268,581	10,555

The cube executed in the canal was less than any previous year with the exception of 1899. No dredging has been done below Deirut since 1885. A channel through the shoal in the river opposite the head of the canal had to be dredged, through which it drew its summer supply. The canal channel was in good order at the end of the year but, as noted in last Year's Annual Report, changes may be expected in the river channel, on the completion of the Asyut Barrage, which may lead to increase of deposit in the canal.

No expenditure was incurred during the year on making or remodelling spurs. Mr. Clowes considers the existing number of 216 pairs of spurs to be sufficient. Some of the spurs have still to be brought up to full section. Mr. Clowes notes that where the spurs have been made high at their roots or points of junction with the bank, the action on the latter immediately downstream of them is severe, and that it would be advisable to alter the form of some of the spurs below which there is evidence of abnormally severe action. This is a point worthy of attention. The only expenditure incurred during the year was £E.110 on revetment to the railway bank.

Spurs in Ibrahimiyah Canal.

The following statement shews the cubes of stone purchased and built into river spurs and revetments during the year and the expenditure incurred on transporting and building Government stone into the same:—

River Protective Works.

CIRCLE.	New stone		Expenditure on transporting and building Govt. stone.	Total Expenditure
	Cube	Cost		
	C.M.	£L.	£L.	£L.
5th Circle ... ..	812	160,320	—	160,320
Girga Directorate ...	20,640	2610,797	311,295	2922,092
4th Circle ... ..	9,661	1622,000	120,410	1742,410
Totals... ..	31,116	4393,117	431,605	4824,822

Besides the above 1,061 cubic metres of stone, costing £E.208,389, were collected on the Nile Bank at Huca and Nawawrah for use in 1901. This brings the total expenditure on Nile protection to £E.5218,211. Only one new spur was built at Akhnim in Girga Province.

The following expenditure was incurred in revetting canal banks below regulators and other important points :—

CIRCLE.	New stone.		Transporting and building.	Total cost.
	Cube.	Cost.		
	C.M.	£L.	£P.	£L.
5th Circle ... ..	2,327	666,100	150,000	816,100
Girga Directorate ...	1,414	324,813	56,783	381,596
4th Circle ... ..	—	—	—	—
Totals... ..	3,741	990,913	206,783	1197,696

Besides this a cube of 1,215 cubic metres costing £E.206,617 was collected on the Kasr Canal bank for future use. This brings the total expenditure under this sub-head to £E.1404,313.

## SECTION II.—NEW WORKS AND IMPROVEMENTS.

*(Exclusive of Special Works).*

Earthwork.

The quantity and cost of earthwork executed in new channels and banks were as follows :—

CIRCLE.	New channels and banks.			
	Quantity.	Cost.	Cost of land.	Total cost.
	C.M.	£L.	£L.	£P.
4th Circle ... ..	77,097	958,985	—	958,985
5th Circle ... ..	184,602	2396,975	129,097	2526,072
Girga Directorate ...	191,556	2142,202	1070,730	3212,932
Girga, rock-cutting ...	18,382	2455,856	—	2455,856
Totals... ..	474,637	7954,018	1199,827	9153,845

The length of the new channels and banks are given in the following statement:—

CIRCLE	LENGTH IN KILOMETRES.	
	New Channels.	New Banks.
4th Circle ... ..	7,005	3,319
5th Circle ... ..	6,922	—
Girga Directorate... ..	18,665	5,992
Total ... ..	32,592	9,311

The bulk of the new earthwork in the 5th Circle was executed in widening the new Marshda Junction, which is the reason the kilometrage, as compared with the cost, appears so small. A lateral road round Esna station costing £E.17,388 was made. The details of the work executed are shewn in Appendix E. The expenditure in the 4th Circle is small, as practically all the new works in that Circle come under the head of "Special Works" for which, in addition to the credit given by the Caisse de la Dette, an allotment from the Ordinary Budget is made.

Appendix K shews the progress made with revetting basin banks, the quantity of stone used, and its cost. Basin Bank Protection.

The total length revetted was 3,863 metres on which 8,070 cubic metres of stone, costing £E.2257,000, was used. The average quantity of stone used per metre run was 2.09 cubic metres, and the average cost was £E.0.584 per metre run. The actual expenditure during the year was £E.1313,000. In addition to the above 34,455 cubic metres stone, costing £E.6,782, was collected for use in 1901. Out of this total 28,518 cubic metres was collected for the new basin banks west of the Yusufi, which is a special work chargeable to the Special Caisse Credit, as shewn in Appendix F. On repairs to basin revetments a sum of £E.149,977 was spent in the 5th Circle.

A list of new masonry works constructed during the year is given in Appendix B. For the improvement of basin-irrigation twelve minor works were built at a cost of £E.3552,000. The new works for improvements and extension of Self-Irrigation and Drainage all come under the head of "Special Works." New Masonry Works for Irrigation.

New  
buildings

In the 5th Circle a sum of £E.1696.000 was spent on completion of rest-houses at Luxor, Esna and Quss and building a gauge for Redissiyah Canal. In Girga Directorate a sum of £E.783.000 was spent on building rest-houses at Baliana and Girga, and £E.126.000 on improvements to Girga office, and a couple of small stores. In the 4th Circle £E.1762 was spent on a new Chief Engineer's office and rest-house at Minia and a house for reises on Minia Regulator. This new building is at present used as the head office of the Circle and head-quarters for the Inspector. The old Daira Sanieh building previously used as the head office was burnt down in June, 1900, and the old palace previously used as head-quarters for the Inspector-General, and Inspector of the 4th Circle is no longer available. The office of the Inspector-General has been removed to Cairo, a change which will often facilitate work by enabling the Inspector-General to discuss matters personally with the officials of the several Ministries. The office and head-quarters of the Inspector of Irrigation, 4th Circle, will be moved to Asyut on the completion of the Barrage.

Masonry  
Works  
remodelled  
and repaired.

A list of masonry works remodelled and repaired is given in Appendix C. In the 5th Circle fifteen works were altered or repaired at a cost of £E.848.000. In Girga Directorate the expenditure was £E.6721.000, the chief item being the repairs of the Sohagiyah Syphon, the failure of which was described in last year's report. A sum of £E.5584 was spent on this work. In the 4th Circle the expenditure was £E.7944.000. The principal item was a sum of £E.3016.000, expended on repairing and improving the Ibrahimiyah regulator at Deirut. The regulator was laid dry, the floor and pier-faces repaired, and the old wooden cill replaced by an ashlar one. Cast-iron grooves suitable for a set of three gates were fixed in the seven vents. Gates and raising gear will be provided when possible. They are much required on an important regulator like this, which has often to work under a heavy head. The method of fixing the grooves is shewn on the accompanying plan, as it is a neat piece of work, which it will doubtless be expedient to copy in similar situations. Another interesting item was the alteration of the releasing gear of twenty of the upper gates of Kosheshah escape. The remaining gates will be dealt with subsequently.

### SECTION III.—AGRICULTURAL ROADS.

The expenditure incurred during the year on construction of new roads was £E.7996.662, all in the Fayum Province. With this sum

Ibrahimiyyah Canal Regulator. Derut.

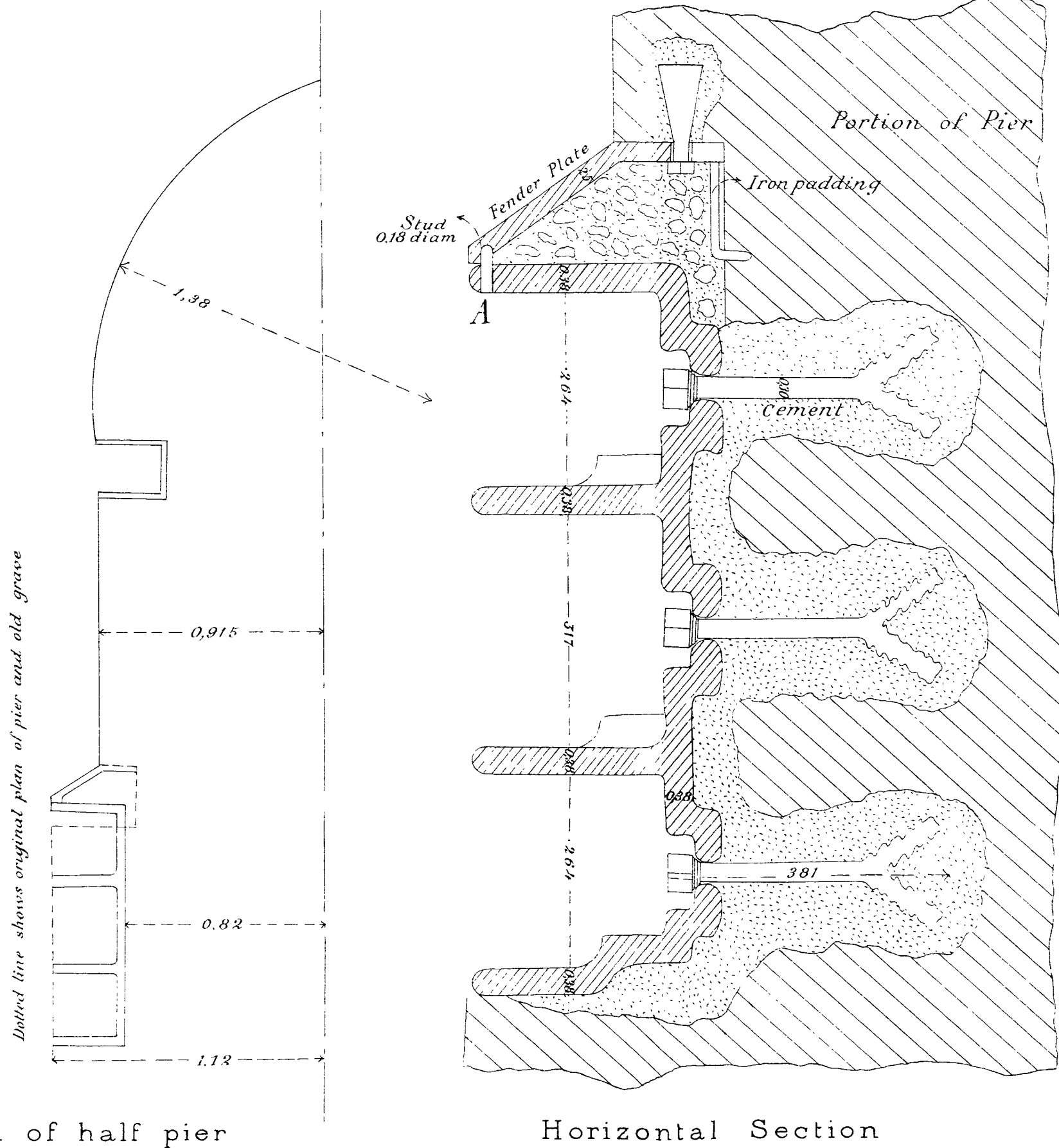
*N.º 1*

Repairs

N.º 2

Scale  $\frac{1}{20}$ Scale  $\frac{3}{20}$ 

*Grouting Shown thus*







68.95 kilometres of new road, commenced last year, were completed and a further length of 30 kilometres constructed. The kilometrage of Agricultural Roads made in the Fayum Province during 1899 and 1900 thus becomes 98.5. The programme approved of in 1898 provided for a length of 222 kilometres, and an expenditure of £E.22643, the rate per kilometre being £E.102.000. The expenditure to date has been £E.12141, which gives a rate of £E.123.000 per kilometre, so it looks as if there would be an excess of about 10% on the original estimate. The expenditure incurred on repairs to existing roads was as follows:—

Province.	Cost of repairs.	Length in kilometres.	Rate per kilometre.
	£E.		£E.
Asyut ... ..	—	—	—
Minia ... ..	1123	91	12,000
Beni Suef ... ..	1022	107	10,000
Fayum ... ..	511	320	1,300

Besides the above a sum of £E.423.000 was spent on repairs to road-bridges in the Fayum. The rates per kilometre in Minia and Beni Suef seem very high, while that in the Fayum is much too low.

An expenditure of £E.95.000 was incurred in closing the final accounts for the unsuccessful borings in the Fayum and at Beni Suef described in last year's report.

Trial Borings  
for water  
supply.

Out of the ten lines in the original concession Nos. 1-4 and No. 7 were reported complete last year. The progress during the year, owing to the financial condition of the company, has been poor. Line 5 and 6 from Edwah to Tamiyah, and Metartaris to Roda, well advanced last year, have been completed. The original line No. 8, Ibshawai to Nezlat, has been abandoned in favour of a branch to the Fayum-Gharaq line along the Wadi Nezlal. This branch has been sanctioned but not yet put in hand. Line No. 9 is also in abeyance as it depends on the above branch. The bridges and earthwork of line No. 10 between Gebala and Semoures, well advanced in 1899, were completed during the year, but platelaying has not been commenced. An extra line from Medinet El Fayum to Edwah along the south side of the Government Railway has been laid, but the embankments have not yet been brought up to full level.

Fayum Light  
Railways.

#### SECTION IV.—BRIDGES TO REPLACE FERRIES.

During the year three bridges, consisting of iron girders and screw piles bearing a timber platform with masonry abutments, were constructed over the Ibrahimiyah Canal at Hawasliyah, Minia and Abu Girg. A fourth bridge of similar design was commenced at Safai. The expenditure incurred during the year was £E.4782.000 mill. Contracts were also placed for the construction of two more bridges at Ibiouha and El Kefour.

#### SECTION V.—SPECIAL SHARAKI CREDIT.

The expenditure on works for prevention of Sharaki was, as shewn in Part I, £E.3540. Of this a sum of £E.2950 was allotted to the 4th Circle as a special grant, the balance being found from the ordinary budget allotments of the 5th Circle and Girga Directorate.

#### SECTION VI.—EXPENDITURE DURING THE YEAR.

An abstract of the expenditure during the year is given in Appendix A, and is as follows:—

	£E.
Establishment and Contingent charges ... ..	33,759
Works ... ..	<u>330,332</u>
Total	£E. 364,091

#### SECTION VII.—ESTABLISHMENT.

Mr. T. H. Clowes was in charge of the 4th Circle throughout the year except during his absence on leave from 25th October to the end of the year, during which period Mr. G. B. Ireland, Director of Works, officiated. The amount of work falling on the Inspector of the 4th Circle, always severe, has been of course largely increased by the heavy expenditure on special works during the past two years. Mr. Clowes has every reason to feel proud of a very heavy year's work well performed. Mahmoud Bey Sidky was in charge of the 5th Circle and Hassan Bey Wassif of the Girga Directorate, and both worked hard and successfully to combat the low flood. The Chief Engineers of Asyut, Minia and Beni Suef deserve much credit for the manner in which they carried out the Rotation Programmes, which were abnormally severe.

K. VERSCHOYLE.

*Inspector-General of Irrigation,  
Upper Egypt.*

## APPENDICES.



## APPENDIX A.

### ABSTRACT OF EXPENDITURE IN 1900 UNDER THE DIFFERENT SUB-HEADS OF THE BUDGET.

SUB-HEADS OF BUDGET.	EXPENDITURE			
	4th Circle.	Girga.	5th Circle.	Total.
	₹E.	₹E.	₹E.	₹E.
SUB-CHAP. I.— <i>Establishment.</i>				
Classified ... ..	9,986	4,032	4,385	18,403
Hors Cadres ... ..	4,000	1,120	1,171	6,291
Total Sub-Chap. I ...	13,986	5,152	5,556	24,694
SUB-CHAP. II.				
Travelling Allowances ... ..	4,149	1,268	1,299	6,716
Telegrams ... ..	180	77	80	337
Dahabiyahs ... ..	540	407	612	1,559
Office Rent ... ..	231	58	104	393
Sundries ... ..	10	10	40	60
Total Sub-Chap. II ...	5,110	1,820	2,135	9,065
SUB-CHAP. III.				
Furniture and Instruments ... ..	50	99	68	217
SUB-CHAP. IV.				
New Works and Sharaki Prevention ...	3,020	4,500	2,791	10,311
Projects Circle ... ..	3,500	—	—	3,500
SUB-CHAP. V.				
Repairs and Maintenance ... ..	9,921	5,951	3,774	19,646
SUB-CHAP. IV AND CORVÉE ABOLITION.				
Earthworks and works for decreasing the cost of maintenance of banks and channels ... ..	75,250	32,950	35,500	143,700
Special new works ... ..	19,250	—	—	19,250
SPECIAL “CAISSE” CREDIT.				
New Works ... ..	120,000	—	—	120,000
NEW AGRICULTURAL ROADS ... ..	7,997	—	—	7,997
SPECIAL CREDIT FOR SHARAKI WORKS ...	930	—	—	930
Ferry Funds ... ..	4,781	—	—	4,781
Total of Works ...	241,699	43,500	42,133	330,332
Grand Totals ...	263,795	50,472	49,824	364,091

\* £E.3,020 were spent on Sharaki prevention.

## APPENDIX B.

LIST OF NEW MASONRY WORKS EXECUTED IN 1900 AND THEIR COST,  
EXCLUSIVE OF SPECIAL WORKS.

NAME OF WORK.	Cost.	Total per Province.	Total per Circle.	Grand Total per Circle.			
	£E.	£E.	£E.	£E.			
5TH CIRCLE.							
<i>Works for Improvement of Irrigation.</i>							
KENA PROVINCE.							
Sayalet Teina head culvert ... ..	207	390					
Culvert Ho-shet El Shekh Fadel ... ..	183						
ASWAN PROVINCE.							
Qandiliyah Canal head regulator ... ..	750	1,900	1,480				
Sayalet El Magnoona head culvert ... ..	340						
<i>Buildings.</i>							
Completion of rest house at Luxor... ..	82	—	216	1,696			
“ “ Esna ... ..	73						
“ “ Quss ... ..	43						
Building a nilometre at Redissiyah Canal ...	18						
GIRGA DIRECTORATE.							
<i>Works for Improvement of Irrigation.</i>							
GIRGA PROVINCE.							
Head culvert for Araba E. Basin Sayalet ...	251	1,329					
Regulator on Gez. Muntasir Sayala ... ..	175						
“ “ Muafin Sayala ... ..	279						
Head culvert for Hod Hikr W. basin Sayala.	316						
Regulator on Ambariyah Canal ... ..	308	743					
ASYUT.—2ND SECTION.							
Red water culvert for Hod Badari W. ... ..	172						
Saliba Ma'asara culvert ... ..	362						
Head culvert for Badari Sahel ... ..	209	2,072					
<i>Carried forward...</i> ... ..	—						

LIST OF NEW MASONRY WORKS EXECUTED IN 1900 AND THEIR COST.  
EXCLUSIVE OF SPECIAL WORKS—*concluded*.

NAME OF WORK.	Cost	Total per Province.	Total per Circle.	Grand Total per Circle.
	£E.	£E.	£E.	£E.
<i>Brought forward...</i> ... ..	—	—	2,072	—
<i>Buildings.</i>				
Baliana rest house stable and wall... ..	396			
Girga .. ..	387			
Latrines in Girga Chief Engineer's Office ...	75			
Store at Saquallah ... ..	11			
„ Galawiyah ... ..	40	—	909	2,981
4TH CIRCLE.				
Works for improvement of Irrigation or Drainage ... ..	Nil.	Nil.	Nil.	Nil.
<i>Buildings.</i>				
Minia Office and rest house ... ..	1,650			
New house for Reises, Minia ... ..	112	—	1,762	1,762

ABSTRACT.

	£E.
5th Circle... ..	1,696
Girga Directorate ... ..	2,981
4th Circle... ..	1,762
Grand Total for Upper Egypt... ..	<u>£E.6,439</u>



# APPENDIX C.

LIST OF MASONRY WORKS REPAIRED AND REMODELLED IN 1900 AND THEIR COST.

NAME OF WORK.	Cost	Total per Province.	Total per Circle.	Grand Total.
5TH CIRCLE.	£E.	£E.	£E.	£E.
KENA PROVINCE.				
Alteration of Assfun syphon ... ..	169			
Repairs to Sayala Sahhara road bridge... ..	94			
"    Zawaida road bridge ... ..	64			
"    Rannan and Hemedat syphons ... ..	22			
"    Gabalein escape ... ..	10			
"    Um Adas culvert ... ..	44			
"    Qibah Sayala culvert ... ..	15			
"    Eriana escape... ..	12			
"    Riti Hod culvert ... ..	12			
Enlargement Chief Engineer's, 1st section office ... ..	131			
Enlargement and repairs to Gabalein and Assfun irrigation plant stores ... ..	30			
Miscellaneous repairs to masonry works ... ..	191			
		794		
ASWAN PROVINCE.				
Repairs to Abu Qandil culvert ... ..	16			
"    Redissiyah rest house ... ..	25			
Miscellaneous repairs to masonry works ... ..	15			
		56		
GIRGA DIRECTORATE.				
GIRGA PROVINCE.				
Repairs to Sohagiyah syphon... ..	5,584			
"    Araba-Idfa escape... ..	63			
Remodelling Enebis saliba regulator ... ..	191			
Repairs to Sohag rest house ... ..	32			
Payment on account of fixing iron angles on ashlar grooves of regulators and escapes...	135			
Petty repairs to regulators, &c. ... ..	286			
		6,291		
ASYUT.—2ND SECTION.				
Repairs to Moria regulator ... ..	174			
"    Abu Zababa escape... ..	57			
"    Badari sahba regulator... ..	19			
"    Matmar saliba regulator ... ..	16			
"    Abou Tig rest house ... ..	10			
Payment on account of fixing iron angles on ashlar grooves of regulators and escapes...	45			
Petty repairs to regulators, &c. ... ..	109			
		430		
			6,721	
			7,569	

LIST OF MASONRY WORKS REPAIRED AND REMODELLED IN 1899 AND THEIR COST—*concluded*.

NAME OF WORK	Cost.	Total per Province.	Total per Circle.	Grand Total.
	£E.	£E.	£E.	£E.
<i>Brought forward...</i> ... ..			7,569	
4TH CIRCLE.				
ASYUT PROVINCE.				
...ing C.I. grooves in the vents of the Brahimiyeh Canal regulator at Deirut ...	3,016			
...airs to Deirut escape... ..	45			
...try repairs to basin bridges... ..	450	3,511		
MINIA PROVINCE.				
...bble pitching below head sluice of Lafsafa Canal ... ..	250			
...try repairs to basin bridges... ..	226			
...pairs to bridges Zahawi, Deir & Mangatin.	117			
...pairs to Itqa bridge ... ..	124			
...try repairs to bridges west of Yusufi... ..	190	907		
BENI SUEF PROVINCE.				
...ainting gates of Koshesha escape... ..	200			
...eration of releasing gear escape.. ... ..	215			
...try repairs to basin bridges... ..	300	715		
FAYUM PROVINCE.				
...pairs to road-bridges ... ..	697			
...try repairs to irrigation works ... ..	809			
...bble pitching at various works... ..	585			
...rears for repairs executed in 1899 ... ..	380	2,471		
<i>General Repairs.</i>				
...ixing angle irons on ashlar grooves of various bridges ... ..	140			
...pairs to inspection houses ... ..	200	340		
			7,944	15,513

ABSTRACT.

	£E.
5th Circle ... ..	848
Girga Directorate ... ..	6,721
4th Circle ... ..	7,944
Total for Upper Egypt... ..	<u>£E.15,513</u>

STATEMENT SHOWING THE NEW BANKS AND CHANNELS MADE IN 1900,  
EXCLUSIVE OF "SPECIAL WORKS"—*continued*.

NAME OF WORK	Length in kilometres.	Quantity of earthwork.	Total quantity.
		C.M.	C.M.
GIRGA DIRECTORATE.			
GIRGA DIRECTORATE.			
Prolongation of Hod Bardis West Sayala ... ..	7.210	44,149	
Sayala Hod Beni Himel West ... ..	3.100	24,175	
Hammam Bank ... ..	3.227	19,557	
Prolongation of Hod Sawamaa Sayalah... ..	2.826	11,058	
.. Sahil Hawawish .. ..	0.330	2,614	
.. Mahgar Haridi Canal... ..	0.116	2,243	
.. in rock-cutting of Haridi Canal ... ..	0.288	18,382	
Sayalah Hod Enebis ... ..	2.989	13,797	
Beni Hilal roadway Sayala ... ..	1.253	7,630	
Sayala from Sahitawiyah Canal to railway bridge in Hod Banga ... ..	0.523	4,971	
			178,576
ASYUT SOUTH.			
Nile Tarrad Hoshet Shaqilqil ... ..	2.765	34,362	
			34,362
Total Girga Directorate ...	—	—	212,938

ABSTRACT.

	Cubic metres.
4th Circle... ..	77,097
5th .. ..	184,602
Girga Directorate ... ..	212,938
Grand Total ...	474,674



# APPENDIX G.

LIST OF MASONRY WORKS EXECUTED UNDER "SPECIAL WORKS" GIVEN IN APPENDIX F.

NAME OF WORK.	Cost.		
	Per Work.	Total.	Total per Project.
	£E.	£E.	£E.
A.—WEST OF YUSUFI PROJECT.			
Regulator and lock Nazlet El Abid... ..	14,788,272	34,545,675	
„ Saqulah ... ..	19,757,403		
<i>Masonry Works in Basins.</i>			
Iron pipes in tarrads for Sefi Hoshas with masonry heads...	580,000	2,420,000	
Two culverts in Salibah Nazlet El Abid... ..	800,000		
Seven magazines for storing regulating timbers ... ..	320,000		
Culvert in Salibah Delhanes ... ..	720,000		
Inspection house at Delhanes ... ..	427,631	427,631	37,393,306
B.—CONSTRUCTION OF REGULATOR AND LOCK AT MAZURAH.			
	23,868,159	23,868,000	23,868,159
C.—FAYUM REMODELLING PROJECTS.			
<i>Culverts.</i>			
Six culverts, Bahr Kasr Banat... ..	440,000	3,431,224	
Three culverts, Bahr Nezeleh ... ..	520,000		
Sahallan Regulator, Bahr Kasr Banat ... ..	195,000		
Abu Um Bridge, Bahr Nezeleh... ..	440,000		
Head sluice, Bahr Kasr Banat... ..	460,000		
Four works, Bahr Abu Gandir... ..	570,576		
Supplementary items for above .. ..	805,648		
<i>Drains.</i>			
Syphon for Abu Awad Drain under Bahr Kasr Banat.. ...	200,000	670,000	
Syphon for Abu Awad Drain under Bahr Nezeleh.. ...	470,000		
Inspection houses Lahur and Kalunshah ... ..	778,000	778,000	4,879,224
Grand Total... ..			66,140,689

## APPENDIX H.

LIST OF NEW AND REMODELLED BANKS AND CHANNELS EXECUTED UNDER  
"SPECIAL WORKS" GIVEN IN APPENDIX F.

NAME OF WORK	Length in kilometres.	Quantity of earthwork.	Cost.	
			Per work.	Total.
		C.M.	£E	£E.
<b>A.—WEST OF YUSUFI PROJECT.</b>				
<i>Banks.</i>				
Seliba Nezlet El Abid ... ..	2'850	121,768	2,044,174	
Tarrad Hod Tukh ... ..	15'000	305,725	3,974,425	
.. Shusha ... ..	8'937	217,562	2,995,855	
.. Qamadin ... ..	16'000	411,715	5,127,085	
.. Bortobat ... ..	3'500	73,432	991,332	
Salibah El Sab ... ..	1'100	28,724	387,774	
Tarrad Hod El Qayar ... ..	8'250	149,674	1,870,925	
.. Hod El Hariqah ... ..	7'979	165,568	1,987,816	
.. Hod Shinarah ... ..	3'600	84,764	1,059,550	
.. Hod Delhanes ... ..	4'980	160,911	1,931,932	
Salibah do. ... ..	4'000	119,185	1,455,137	
Hoshah Banks Hod Bortobat... ..	0'575	6,182	83,457	
.. Qayat ... ..	1'988	16,826	228,378	
Salibah Saqula (part) ... ..	1'340	31,350	600,000	
Totals ... ..	80'099	1,896,386	25,037,840	25,037,840
<i>Channels.</i>				
Canal Zawiet Hatim ... ..	12'000	271,736	3,532,568	
Channel Hod Qamadin ... ..	1'000	20,765	249,180	
.. Hod Tirta ... ..	1'500	30,450	365,400	
Canal El Sab ... ..	6'000	189,224	2,601,830	
.. Kafr El Salhim ... ..	18'090	238,358	3,456,190	
Drain Delhanes ... ..	0'600	3,384	49,068	
.. for Shinarah escape ... ..	1'000	11,188	160,000	
Total Channels ... ..	40'100	765,105	10,414,236	10,414,236
Totals Banks & Channels west of Yusufi ...	120'199	2,661,491	35,452,076	35,452,076

LIST OF NEW AND REMODELLED BANKS AND CHANNELS EXECUTED UNDER  
"SPECIAL WORKS" GIVEN IN APPENDIX F.—*continued.*

NAME OF WORK.	Length in kilometres.	Quantity of earthwork.	Cost.	
			Per work.	Total.
		C.M.	£E.	£E.
<i>Brought forward</i> ... ..	120.199	2,661,491		35,452,076
<i>B.—FAYOUM REMODELLING PROJETS.</i>				
<i>Canals.</i>				
Bahr El Nezlak, 1st Reach ... ..	17.643	454,271	13,628,130	
.. Kasr Banat, 1st Reach and branches ...	17.000	343,401	5,494,420	
.. Kasr Banat, 2nd Reach... ..	13.000	95,000	3,157,322	
.. Sahf (part) ... ..	6.340	32,830	410,379	
Bahr- Alam, Metartaris and Edwah (part payment) ... ..	5.308	35,000	400,000	
Total Canals ... ..	59.291	959,502	23,090,251	
<i>Drains.</i>				
Tagin Drainage System (part payment) ...	14.683	153,877	2,760,000	
Total Canals & Drains, Fayoum ...	73.974	1,113,379	25,850,251	25,850,251
Grand Total ... ..	194.173	3,775,368	—	61,302,327

## APPENDIX K.

## RECOVERY OF BASIN BANKS WITH SLOPES.

PROVINCES	LENGTH REVEALED.			QUANTITY AND COST OF STONE USED IN REVEALMENT IN 1900								Stone collected in 1900 for use in 1901.	
	Previous to 1900.	In 1900.	To end of 1900.	Quantity collected in		Total quantity	Quantity per linear metre.	Cost of stone collected in		Total cost	Cuts per linear metre.		
				1899.	1900.			1899.	1900.				
	M.	M. f	M.	C.M.	C.M.	C.M.	C.M.	£ s d	£ s d	£ s d	QTY.	QTY.	Cost
4TH CIRCLE.													
Beni Suef ... ..	30,356	—	30,356	—	—	—	—	—	—	—	—	1,222	900,000
Minia ... ..	27,612	—	27,612	—	—	—	—	—	—	—	—	28,518	5,551,000
Assut North ... ..	51,775	1,418	53,223	2,000	968	2,968	2·05	500,000	531,000	1,031,000	0·711	—	—
Total...	109,743	1,418	111,221	2,000	968	2,968	2·05	500,000	531,000	1,031,000	0·711	32,738	6,451,000
GIRGA DIRECTORATE.													
Assut South ... ..	16,282	552	46,834	—	711	711	1·35	—	156,000	156,000	0·282	—	—
Girga ... ..	13,198	1,513	15,011	1,053	2,225	3,278	2·12	181,000	110,000	621,000	0·402	1,717	331,000
Total...	89,780	2,065	91,875	1,058	2,969	1,022	1·92	181,000	596,000	777,000	0·371	1,717	331,000
5TH CIRCLE.													
Kena ... ..	60,815	320	61,135	1,050	30	1,080	3·37	112,000	7,000	149,000	1·400	—	—
Aswan ... ..	—	—	—	—	—	—	—	—	—	—	—	—	—
Total...	60,815	320	61,135	1,050	30	1,080	3·37	112,000	7,000	149,000	1·400	—	—
Grand Total...	26 0368	3,863	261,231	4,103	3,967	8,070	2·09	1,123,000	1,131,000	2,257,000	0·581	31,155	6,782,000



## APPENDIX L.

STATEMENT SHEWING DATES ON WHICH THE PRINCIPAL EVENT OF "SARF" OCCURRED  
IN THE 4TH CIRCLE DURING 4 YEARS.

NOTE.—Special measures had to be taken in the low flood of 1899 and the usual programme could not be followed, consequently dates for that year are not given.

PROVINCE.	1896	1897	1898	1900
<b>ASYUT PROVINCE.</b>				
Feeders from Ibrahimieh Canal closed ...	5th Oct.	8th Oct.	8th Oct.	1st & 2nd Oct.
Gebel Asyut bridge nearly closed ...	5th Oct.	8th Oct.	8th Oct.	8th Oct.
Cut made in Tarrad of Hod Itqa ...	13th Oct.	13th Oct.	14th Oct.	Not made.
Cut made in Salibah Beni Khalid * ...	14th Oct.	10th Oct.	11th Oct.	10th Oct.
Delgawi and Badraman escapes opened ...	15th Oct.	9th Oct.	10th Oct.	9th Oct.
Cut made in Tarrad of Hod Ashmumin * ...	16th Oct.	11th Oct.	13th Oct.	10th Oct.
Um Afrita regulator opened ...	—	11th Oct.	18th Oct.	9th Oct.
Sabakhah Canal head closed ...	20th Oct.	17th Oct.	17th Oct.	12th Oct.
Supply in Bahr Yusuf reduced ...	20th Oct.	18th Oct.	17th Oct.	14th Oct.
<b>MINIA PROVINCE.</b>				
<i>East of Yusufi.</i>				
Cut made at south end of Tarrad Hod Tanashawi ...	Not made.	8th Oct.	Cut open.	Not made.
Abu I-mail Bridge Salibah Tanashawi opened	17th Oct.	12th Oct.	14th Oct.	15th Oct.
Talata and Sabahah Bridge ..	18th Oct.	12th Oct.	14th & 15th Oct.	12th & 15th Oct.
Zanuba and Nezlet El Abid Escapes Hod Tanashawi opened ...	17th Oct.	12th Oct.	14th Oct.	partially 12th Oct. fully 15th Oct.
1st cut made in Tarrad Hod Tanashawi ...	18th Oct.	12th Oct.	14th Oct.	Not made.
2nd .. .. .	—	12th Oct.	—	Not made.
1st .. .. . El Qurn ...	18th Oct.	12th Oct.	14th Oct.	14th Oct.
2nd .. .. .	—	12th Oct.	—	15th Oct.
Regulator in Salibah El Qurn opened ...	19th Oct.	12th Oct.	15th Oct.	19th Oct.
Regulator in Salibah Tahawi opened ...	19th Oct.	12th Oct.	15th Oct.	17th Sept.
Cut made in Tarrad of Hod El Deir ...	19th Oct.	13th Oct.	15th Oct.	16th Oct.
Regulator in Salibah Hod El Deir opened ...	19th Oct.	13th Oct.	17th Oct.	17th Oct.
.. .. . Mangatin ..	19th Oct.	13th Oct.	16th Oct.	19th Oct.
.. .. . Membal ..	19th Oct.	13th Oct.	16th Oct.	18th & 19th Oct.
.. .. . Bardenhah ..	?	?	?	20th Oct.
Cut made in Tarrad Hod Mangatin ...	—	13th Oct.	—	19th Oct.
.. .. . Membal ...	—	14th Oct.	—	25th Nov.
.. .. . Tabawi ...	—	14th Oct.	—	16th Oct.
El Gamal escape opened ...	20th Oct.	14th Oct.	17th Oct.	28th Oct.
Regulator in Salibah Garmusi opened ...	20th Oct.	14th Oct.	17th Oct.	21st Oct.
Cut made in Tarrad Hod Salaqusi ..	20th Oct.	15th Oct.	17th Oct.	21st Oct.

\* Regulators have replaced cuts.

STATEMENT SHEWING DATES ON WHICH THE PRINCIPAL EVENTS OF "SARF" OCCURRED  
IN THE 4TH CIRCLE DURING 4 YEARS.

PROVINCE.	1896	1897	1898	1900
<i>West of Yusuji.</i>				
Nezlet El Abid regulator fully opened ...	Not built.			9th Oct.
Cut made in Salibah Nezlet El Abid ...	Not in existence.			12th Oct.
Regulator in Salibah Tukh opened ...	"	"	"	16th Oct.
Cut made in Tarrad Qumadin to feed the Hod from the Yusuji ...	"	"	"	15th Oct.
Regulator in Salibah Qumadin opened ...	Not in existence.			27th Oct.
Cut made in Salibah Qumadin ...	19th Oct.	14th Oct.	16th Oct.	13th Oct.
" " Shushah* ...	19th Oct.	14th Oct.	16th Oct.	17th Oct.
" " Tarrad ...	—	—	—	18th Oct.
Regulator in Salibah Terfa opened ...	—	—	17th Oct.	24th Oct.
" " El Der ...	—	—	18th Oct.	20th Oct.
Saqula Regulator fully opened ...	Not built.			unfinished so not used.
Cut made in Tarrad Bartobat ...	" "			15th Oct.
Regulator in Salibah " opened ...	" "			25th Oct.
" " Qayat " * ...	" "			18th Oct.
Cut made in Salibah Hariqah ...	22nd Oct.	17th Oct.	19th Oct.	19th Oct.
" " Shenarah ...	22nd Oct.	17th Oct.	19th Oct.	After Sarf.
Escape of Hod Shenarah opened ...	—	—	—	23rd Oct.
" " Delhanes " ...	—	—	—	23rd Oct.
BENI SUEF.				
Mazurah Regulator fully opened ...	Not yet finished.			
Regulators in Salibah Sultani opened ...	22nd Oct.	22nd Oct.	19th Oct.	26th Oct.
" " Nina " ...	22nd Oct.	23rd Oct.	20th Oct.	1st Nov.
" " Nuera " ...	22nd Oct.	24th Oct.	19th Oct.	31st Oct.
" " Bahabshin opened ...	Not in existence.			30th Oct.
Cut made in Tarrad of Hod Nina* ...	27th Oct.	26th Oct.	19th Oct.	1st Nov.
Upper gates of Koshesha Escape released ...	23rd Oct.	20th Oct.	18th Oct.	Not opened.
Lower " " " opened ...	—	—	—	28th Oct. part.
Attwab escape opened ...	25th Oct.	19th Oct.	19th Oct.	3rd Nov. fully After Sarf.

\* Regulators have replaced cuts.

## APPENDIX M.

STATEMENT SHOWING THE AREAS UNDER DIFFERENT CROPS IN THE PROVINCES OF UPPER EGYPT, INCLUDING GOVERNMENT AND WAKF'S LAND AND LAND OF THE DAIRA SANIHI DOMAINS, FROM THE COMMENCEMENT OF THE FLOOD OF 1899 TO THAT OF 1900.

Province	Total area irrigated and cultivated	Waste land - "Boor"	Total area of crops	Area double cropped	Area of cultivated land	New Crops			Winter Crops					Summer Crops				
						Maze, Ibrahim Khabaza, Shamm and southern	Rice	Total Nile crops	Wheat	Barley	Others	Total winter crops	Cotton	Sugar-cane	Melons and Sorghum	Veg. tubers	Total 2d crops	Gardens
Beni Suef .. ..																		
Fayum .. ..	140,028	88,768	151,200	193,305	272,555	141,000	27,051	168,051	66,652	254,536	87,825	242,245	35,486	142	21	2,393	38,312	2,639
Minia .. ..																		
Assut .. ..																		
Giza .. ..																		
Kaiba .. ..																		
Aswan .. ..																		
Total .. ..																		
Column .. ..	A	B	C	D	E	F						G					H	K

NOTE. A=B+C  
C=D+E  
and C=E+F+G+H+K.

NOTE.—This statement is compiled from Agricultural statistics supplied by the Administration of Finance. During the past year these statistics, owing, as explained by the Controller of Direct Taxes, to the prevalence of Sharaki were not compiled in Upper Egypt for winter or Nile crops, so the statement cannot be completed.

# APPENDIX S.

TABLE I.—STATEMENT SHOWING THE QUANTITY OF SUGAR-CANE CRUSHED IN THE DAIRA SANIEH FACTORIES IN MIDDLE AND UPPER EGYPT IN SEASON 1899-1900 AND THE AMOUNT OF No. 1 SUGAR PRODUCED.

NAME OF FACTORY.	Cane crushed in kantars.	Out-turn of No. 1 Sugar in kantars.
MIDDLE EGYPT.		
Biba ... ..	1,248,592	112,766
Magagah ... ..	2,062,381	191,281
Matai ... ..	1,295,937	123,282
Minia ... ..	1,799,839	171,991
Abu Qirgas ... ..	1,136,094	113,330
Roda ... ..	2,137,639	227,707
Total, Middle Egypt ... ..	9,680,482	940,357
UPPER EGYPT.		
Dabaiyah ... ..	651,514	65,079
Armant ... ..	771,301	79,688
Mata'anah ... ..	747,188	76,347
Total, Upper Egypt ... ..	2,170,003	211,114
Grand Total ... ..	11,850,485	1,161,471

APPENDIX S—*continued.*

TABLE II.—SUGAR-CANE CRUSHED AND SUGAR OUT-TURNED BY THE DAIRA SANIEH FACTORIES DURING THE LAST TWENTY-ONE YEARS.

Factory season.	From crop of.	Quantity of cane crushed in kantars.	Total sugar produced in kantars	Nature of summer level preceding factory season	REMARKS.
1880	1879	8,402,833	605,623		The total sugar produced includes the three qualities Nos. 1, 2, and 3.
1881	1880	2,365,642	182,096		
1882	1881	7,336,192	603,225		
1883	1882	4,880,094	422,622	Unfavourable.	
1884	1883	8,445,247	667,451	Favourable.	
1885	1884	9,918,201	854,884	Very favourable.	
1886	1885	11,258,057	973,500	Fair.	
1887	1886	10,986,224	934,376	Favourable.	
1888	1887	10,411,640	861,352	Favourable.	
1889	1888	8,382,837	790,197	Fair.	
1890	1889	7,602,302	695,870	Very favourable.	
1891	1890	11,130,799	1,149,893	Very low.	
1892	1891	12,522,918	1,329,627	Low but early rise.	
1893	1892	12,755,107	1,207,164	Low and late rise.	
1894	1893	14,253,813	1,427,608	Very favourable.	
1895	1894	14,601,832	1,485,345	Favourable.	
1896	1895	15,217,050	1,564,972	Very favourable.	
1897	1896	13,253,433	1,882,979	Very favourable.	
1898	1897	12,369,140	1,176,067	Very favourable.	
1899	1898	11,636,689	1,173,871	Low.	
1900	1899	12,680,860	1,340,983	Very favourable.	
1901	1900	9,680,482	1,057,902	Very low but early rise.*	

\*This is calculated from No. 1 Sugar produced by adding one-eighth to allow for Nos. 2 and 3 Sugar, i.e.:—

	Kantars
No. 1 Sugar ... ..	940,357
Nos. 2 and 3 Sugar ... ..	117,545
Total... ..	<u>1,057,902</u>

NOTE.—The above only includes the Middle Egypt factories, the cane of which is irrigated by the Ibrahimiyah Canal.

APPENDIX S—*continued*.

TABLE III.—SUGAR-CANE CRUSHED AND SUGAR OUT-TURNED IN SULTAN PASHA'S FACTORY AT DAMARIS DURING THE LAST SEVENTEEN YEARS.

Factory Season.	From crop of	Quantity of cane crushed in kantars.	Total sugar produced in kantars.	REMARKS.
1884	1883	258,855	23,199	The total sugar produced includes the three qualities Nos. 1, 2, and 3.
1885	1884	258,405	24,720	
1886	1885	250,426	23,705	
1887	1886	272,984	23,903	
1888	1887	274,549	23,636	
1889	1888	276,505	24,648	
1890	1889	266,218	23,783	
1891	1890	228,421	31,609	
1892	1891	382,791	36,161	
1893	1892	442,187	37,275	
1894	1893	471,076	40,253	
1895	1894	545,274	47,429	
1896	1895	541,202	51,954	
1897	1896	587,462	59,543	
1898	1897	451,390	40,566	
1899	1898	479,822	48,761	
1900	1899	466,027	46,732	
1901	1900	524,466	54,966 *	

\* This is calculated from No. 1 Sugar produced by adding one-ninth to allow for Nos. 2 and 3 Sugar, i.e.—

	Kantars.
No. 1 Sugar ... ..	49,469
Nos. 2 and 3 Sugar ... ..	5,497
Total. ... ..	<u>54,966</u>

NOTE.—The one-ninth allowed for Nos. 2 and 3 Sugar is the same proportion as used in former years and has been adhered to for purposes of comparison; the actual proportion, is, however, as much as one-seventh.

APPENDIX S—*concluded*.

TABLE IV.—STATEMENT SHOWING THE QUANTITY OF SUGAR-CANE CRUSHED IN THE FACTORIES OF THE "SOCIÉTÉ GÉNÉRALE DES SUCRERIES DE LA HAUTE-ÉGYPTÉ" AND THE QUANTITY OF NO. 1 SUGAR PRODUCED DURING THE PAST THREE YEARS.

SEASON.	FACTORIES						TOTAL.	
	Naga Hamadi		Shekh-Fall.		Hawandiyah.			
	Cane crushed in kantars.	Outturn of No. 1 sugar in kantars.	Cane crushed in kantars.	Outturn of No. 1 Sugar in kantars.	Cane crushed in kantars.	Outturn of No. 1 Sugar in kantars.	Cane crushed in kantars.	Outturn of No. 1 Sugar in kantars.
1896-1897	644,438	68,888	1,822,204	191,109	1,333,320	135,554	3,799,962	395,551
1897-1898	1,661,418	108,870	2,782,670	238,574	654,808	56,990	5,098,896	409,434
1898-1899	1,776,825	173,263	3,158,415	304,949	1,315,080	125,798	6,250,320	604,002
1899-1900	1,618,341	168,577	3,169,252	301,191	1,191,278	105,641	5,978,871	575,409
1900-1901	—	—	—	—	—	—	6,908,772	682,587

ADMINISTRATION REPORT  
OF THE  
IRRIGATION DEPARTMENT IN LOWER EGYPT  
For 1900

BY  
MAJOR R. H. BROWN, C.M.G.,  
*INSPECTOR-GENERAL OF IRRIGATION IN LOWER EGYPT.*





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# ADMINISTRATION REPORT OF THE IRRIGATION DEPARTMENT IN LOWER EGYPT FOR 1900.

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## CHAPTER I.

### WINTER. SPRING AND SUMMER IRRIGATION.

Before the flood season of 1899 was nearly over, anxiety was felt by all who do business in cotton, both cultivators and export merchants, about the prospects of the coming summer's water supply. It was known, almost as a certainty, that, after so deficient a flood as that of 1899, there would be a short summer supply to follow, and it was feared that it would be exceedingly short and that the consequences would be disastrous to the cotton crop. The fears were fully realised so far as the deficiency of the water supply was concerned, but not as to the consequences. Few were sanguine enough to hope that any scheme of distribution could be enforced to such purpose as to extract so high a duty of the available discharge that the whole cotton crop should be saved.

This, however, was successfully accomplished. According to almost universal testimony, the cotton crop at the end of August, after the scarcity of water had ceased, promised to be an unusually good one and a 6-million kantar crop was predicted by many. But fogs and cold, and weather such as cotton abhors, came in September, and the estimate fell till it had reached  $5\frac{1}{4}$  millions at the end of the year. It is stated, more, I think, as a probable theory than as an established fact, that the cotton suffered to a greater degree from the inclement weather than it would have done, had not its constitution been enfeebled by the insufficiency of waterings during the preceding months. However that may be, it is a matter for congratulation that, with so little water to distribute, so much as 5 millions kantars of cotton has been produced. If the figure should eventually reach  $5\frac{1}{4}$  millions, as estimated, the gross yield of the crop will be greater than any previous to 1895. No doubt the yield per feddan was lower than it had been during some of the preceding favourable years, as it is generally accepted that the area put under cotton was greater than ever before, a fact that made the distribution of the scanty supply of water a still more difficult problem to solve. Part of the increase in area was directly due to the

nature of the programme of distribution adopted, inasmuch as it was expressly drawn up to suit the requirements of the cotton cultivation without regard to the needs of the rice crop. Consequently rice was not sown where canal water was a necessity for its cultivation, but the land was put under cotton instead, so that much of the regular rice area was added to the cotton area, and accounted for part of the increase, but not all of it. For some cultivators argued with doubtful logic, that, as water would be deficient and their cotton crop would probably give a diminished yield per feddan, it was good policy to plant an increased area, so that the decrease per feddan might be compensated by the increase in the total yield of cotton on the estate. If all estate owners had adopted this policy, it is probable that the result would have been a nett loss instead of a net gain. As comparatively few only adopted it, or could adopt it, they probably benefitted at the expense of others.

As the measures taken for saving the cotton crop were undeniably successful, and as similar problems may present themselves in the future, it will be useful to record in detail what arrangements were made to deal with the situation, and how they were carried out.

The situation was this. On 1st January, 1900, the river level at Aswan was  $1\frac{3}{4}$  metres lower than the average. The flood, that had just passed, was, in Lower Egypt, the lowest on record in every respect. In Upper Egypt, though its maximum was 12 kirats (inches) higher than the flood of 1877, its mean level (for the flood period) was lower than that of any other flood recorded. Consequently it was to be expected that the spring-level of the whole country in the coming summer would be unusually low, and the springs along the river bed and infiltration from its sides would be less than ever before, and would contribute comparatively little to the river discharge. So the worst had to be provided for.

It had already been decided, independently of any considerations arising from the prospect of a low summer Nile (see page 138 of the Irrigation Report for 1899) to distribute the available supply to the six main Delta canals, in just proportion to the areas served by them, by the common-sense method of regulation on their Head Works. Two-fifths of the total available supply was to be given to each of the 1st and 2nd Circles, and the remaining fifth to the 3rd Circle. The manner of calculating the details of the distribution will be made clear by examples further on.

During the month of January it was decided to carry out the following measures:—

(1) Temporary dams were to be made on both branches of the Nile near their tails, above Rosetta on the one branch, and below Damietta on the other, with the object of excluding the salt water of the Mediterranean from the lower reaches of the river, and so to keep the water fresh enough for the irrigation of those lands which were served by pumps along the river banks.

(2) The rotation programmes were to be drawn up and published at an early date, and were to be framed in such a way as to serve the needs of the cotton crop to the utmost, without regard for the rice crop, as there was not enough water for both. This decision—to disregard the rice crop—simplified the scheme of rotations and made it possible to distribute the available water in such an economical manner as to irrigate the maximum area of cotton possible.

(3) Powers were to be obtained to prevent the commencement of the sowing of the maize crop until such date as the Minister of Public Works should decide that it could be safely allowed. This was an absolute necessity: for otherwise the cotton plant, that had been safely brought through the early stages of growth, would have perished before maturity and have given no yield. The recognition of this necessity has been the natural consequence of actual experience for some years past, even with fairly good summer supplies. There was, therefore, no hesitation among Irrigation Officers in admitting the absolute necessity for the measure in an exceptionally bad year. Without this precaution the careful distribution of water by a well-considered programme of rotation would have been labour lost. On the other hand, without a well-worked system of rotations the precaution would have been useless, as there would have been but a small area of cotton to save. The principal measure that saved the crop was the strict application of an elaborate system of rotations, so framed in the interests of the cotton crop that rice cultivation could not be attempted.

The programmes were drawn up, discussed and decided on during February, and were published as soon as drawn up, the 14th March being fixed as the date for their first application. It was, however, found unnecessary to apply them until 4th and 5th April in Kaliubiyah and Sarkiyah, and 16th and 17th April in the other Provinces of Lower Egypt. (In Dakahiliyah a partial application only of the programme had to be made between the 4th and 17th April). From which it is evident that the supply had been sufficient to not only to complete the irrigation of the winter crop, but also to provide for the earlier sowings of cotton. In pursuance of the new policy, referred to in last year's Report, of giving as good a water supply as is available

up to the maximum that can be utilised to advantage, the Barrage was freely regulated upon and an upstream level of R.L. 13·80 produced in February and maintained till 19th March, with the exception only of six days (8th to 13th March), when the level was let fall to produce a flush in the Damietta Branch to drive out the salt water. To effect this, the upstream level was reduced 30 centimetres on the 8th and 9th March by the partial opening of the Damietta Barrage, while, at the same time, the three Barrage Canals had their discharges reduced by the partial closing of their Heads. This two-days' flush having been given, the canal Heads were reopened fully and the Barrage gates were closed entirely on the 10th, and caulking, to stop leakage round and between the gates, was at once undertaken. On the 13th March also the equal distribution of the supply between Circles was commenced by regulation on the canals which, with Heads fully open, took more than their share. In consequence of these measures the Barrage upstream level rose gradually to R.L. 13·85 on 16th March, after which date a slow and continuous fall began. The maintenance of such unusually high levels during February and early March was of great benefit to the winter crops. The complaints of former years were not repeated and the winter crop was a heavy one.

On 4th April, when rotations began in Kaliubiyah and Sharkiyah, the Barrage upstream level had fallen to R.L. 13·43. On 14th April, when rotations began in the other provinces, the upstream level was R.L. 13·33.

In drawing up the rotation programmes, it had first to be decided in how many days an engine and pump could irrigate the area dependent on it. The period was finally fixed at six days. The next point to be decided was what was the extreme interval between waterings that was permissible without too great a risk to the health of the cotton plant.

The maximum interval between the six days' period of working was fixed at twenty-two days, that is one watering would be given during the full period of twenty-eight days; but this extreme was not to be worked to unless absolutely necessary. The programme that came into force on 15th April gave one watering in twenty days by dividing the system of canals, forming one group, into three sections; each section working for six days, and stopping for fourteen days. This arrangement provided one day between the working periods of the upper and middle sections, and again one day between the middle and lower sections, during which no pumps were allowed to work except by special permission. These days of general stoppage were intended to provide for the filling of the channels of the next lower section, so that the

water might reach the tail ends of the sections, and the pumps at the tails have as good a supply from the commencement of their six days' period as those higher up the canals. These intermediate general stoppage days were also made use of to give water to those who had been badly supplied during their proper working period.

As the supply of water decreased, it was found impossible to give a watering every twenty days, and the period was increased successively to twenty-four and twenty-eight days. The six-day working period was always maintained, and the change to the full period of twenty-four was effected by introducing two general stoppage days after each working period, still preserving the division into three sections. When it became necessary to apply the extreme limit of one watering in twenty-eight days (which had eventually to be done over the greater part of the Delta), the separate groups of canals were divided into four sections, each section working, as before, for six days, with an interval of one day between the different section working periods. The following table will show the principle on which the programmes were drawn up:

Programme No. 1	{ One watering in 20 days. Division into three sections, A, B & C.
Section A works	6 days : B & C stop working.
General stoppage	1 day.
Section B works	6 days : A & C stop working.
General stoppage	1 day.
Section C works	6 days : A & B stop working.
Total	<u>20</u> days.

(The 2nd Circle omitted the two days of general stoppage and gave a watering in 18 days.)

Programme No. 2	{ One watering in 24 days. Division into three sections, A, B & C.
Section A works	6 days : B & C stop working.
General stoppage	2 days.
Section B works	6 days : A & C stop working.
General stoppage	2 days.
Section C works	6 days : A & B stop working.
General stoppage	2 days.
Total	<u>24</u> days.

Programme No. 3	{ One watering in 28 days. Division into four sections, D, E, F & G.
Section D works	6 days : E, F & G stop working.
General stoppage	1 day.
Section E works	6 days : D, F & G stop working.
General stoppage	1 day.
Section F works	6 days : D, E & G stop working.
General stoppage	1 day.
Section G works	6 days : D, E & F stop working.
General stoppage	1 day.
Total	<u>28</u> days.



By giving special permissions for working on the general days of stoppage to those who had not had full share during their proper working period, some of the difficulties of distribution were met. It was also arranged that, if the tail reaches of any section did not get water in their proper turn, they should be given water with the section whose turn came next, as it would then be possible to get water to them, since all the pumps above them on the same branch would be stopped.

There were complications in the actual programmes adopted, especially in Sharkiyah, as it was found impossible to apply the system given above without modifications, but, generally speaking, all the programmes had this same framework as the basis of their formation.

There were, however, some branch canals exceptionally situated, as a rule near the Barrage, to which the general programme could not be applied. Special programmes for twenty-one of the most troublesome canals in the 2nd Circle had to be made out: the most severe of these special programmes allowed only four days' working out of thirty days. Included among these twenty-one canals were the Hafir Shehab Din, Bahr Sef and Nanaiyah Canals, the only canals of any size requiring special arrangements.

There were unforeseen difficulties with the upper branches taking off from the Rayyah Tewfiki in consequence of the unprecedentedly low levels in the main canal. In former years the Rayyah Tewfiki Head used to be left fully open in summer, and it received, in consequence, a discharge greatly in excess of its just share. As, for the first time in 1900, the Head was regulated on in summer to reduce the discharge to its proper proportion, and the introduction of this new method of distribution between the different Circles coincided with an exceptionally short supply in the river, the change of summer levels in the Rayyah Tewfiki was more pronounced than had been expected, and the beds of the upper branches, taking off from it, were found to be too high to draw in the proper discharges. Some of them had to be closed and dug deeper, and afterwards be given water out of their turn, which introduced perturbations in the working of the rotations on other canals. The dredging of the Basnsiyah Canal was not executed in good time and difficulties arose also on this canal in consequence of deficient water-way after the commencement of rotations. The Sharkiyah Province has also a difficulty. Its system of canals is such that it is not practicable to subdivide it into three sections: and either the two-section, or four-section sub-division had to be perforce adopted, and a complicated overlapping of the working periods had to be

introduced into the programme in order that each section might get its fixed period of six days' working.

On account of the light nature of the soil along the lower reaches of the Ismailiyah Canal, the cultivators petitioned that arrangements might be made for giving them more frequent waterings. Their wishes were met, without giving them more than their just share, by allowing them waterings for periods of three days at half intervals instead of six days at full intervals.

The 3rd Circle had no special difficulties. Its first branches take off from the main canal at such a distance from the Barrage that it is always *possible* by regulation to raise the water level as much as is necessary. Moreover, the relief afforded by the absence of any demand for rice cultivation was probably more felt in the Province of Beherah than elsewhere. But the valuable vegetable and pleasure gardens in Alexandria required special orders in each case, and so a somewhat troublesome complication was introduced.

All the Inspectors of Irrigation agree that the people showed greater respect for the regulations laid down, as to the times when they might and might not take water, than ever before. The respect was, to a great extent, due to the fear of having pump licences cancelled, which had been created by a few examples that had been wisely made by the Inspector of the 2nd Circle during the previous years. The Mudiriah Council, which tries cases of breach of regulations relating to irrigation matters, are too ready to acquit the accused on any plea. The offence may be proved and be brought home to the accused, but on such grounds as that his name or his apparent age is wrongly given in the document ("mahdar") drawn up at the time the offence was detected, the culprit is acquitted. Still the proving of the committal of the offence is of use in the case of pumps being worked against order, as the Government has the power of cancelling the licence for the engine on account of the breach of the conditions contained in it. Such a procedure has the great advantage of punishing the owner of the engine and pump, and is far more efficient as a deterrent than punishing any of the owners' employés. The licence being cancelled, the owner of the pump has to make application and pay the fees as if for a new pump, which the Government is at liberty to grant or refuse. In every case, hitherto, the new licence has been granted, but the opportunity is seized of reducing the pump to its proper dimensions in proportion to the area served, and a time limit is entered in the new licence. But in the case of an obstinate and incorrigible offender, the new licence would be refused absolutely.

Though the adoption of this policy and its application in a few chosen cases had a good effect, the chief cause of the success, with which the arrangements for the distribution of water were carried out, must be ascribed to the efforts of the Inspectors of Irrigation themselves : for it was they who elaborated the troublesome details of the rotation programmes, and made arrangements for their effective application. As "peace hath its victories no less renowned than war," it is only right that these gentlemen should be "mentioned in despatches." Mr. John Langley was in charge of the 1st Circle, Mr. K. E. Verschoye of the 2nd, and Mr. C. E. Dupuis of the 3rd, and they deserve all honourable mention for the part they played in the irrigation of the Delta during the trying summer of 1900.

Both the Alexandria General Produce Association and the British Chamber of Commerce of Egypt have addressed official letters of thanks to the Ministry of Public Works for the manner in which the Irrigation Officials of all ranks carried out their duties and ensured the just distribution of the water.

The Behera Society's Report for the year 1900 contains welcome testimony to the success of the measures adopted for the distribution of water in the following passages devoted to Irrigation and Crops respectively.

#### IRRIGATION.

"Comme nous l'avons fait remarquer dans notre rapport de l'année dernière, la provision d'eau pendant l'hiver a été meilleure que dans toute autre année précédente.

"Les craintes ressenties au sujet d'un manque total d'eau en été ne sont point réalisées, grâce aux excellentes mesures adoptées par le service des irrigations.

"La très petite quantité d'eau disponible a été si bien distribuée au moyen du système d'irrigation par rotations, que même dans les régions éloignées, où s'étend le domaine de la Société, les plantations de coton ont été arrosées à intervalles réguliers et le dégât causé par la pénurie d'eau a été insignifiant.

"Quant à la crue, elle a été abondante."

#### RÉCOLTES.

"Les récoltes de l'hiver ont donné un meilleur rendement que d'habitude, par suite de l'excellente fourniture d'eau à laquelle nous avons fait allusion.

“Le coton qui n'a pas souffert de la pénurie d'eau pendant l'été, a été endommagé par les brouillards en septembre. On peut estimer à 15 % la perte en dérivant.

“La surface plantée a été plus grande qu'en 1899, mais le rendement moindre, toutefois avec la hausse des prix, la somme réalisée a été plus importante.

“Les longs intervalles d'arrosage qu'il a fallu appliquer par suite de la pénurie d'eau en été, ont rendu la culture du riz impossible. Mais la Société, grâce aux pompes qu'elle a sur le Nil et qui ne sont point assujetties au système de rotation, a pu semer une surface limitée en riz. Un tiers environ de la récolte s'est perdu, car le Nil même a été à sec.

“Les récoltes Nili ont été exceptionnellement bonnes. L'augmentation de la surface cultivée en maïs et en helba est une preuve de l'amélioration de la qualité du sol.”

As the lands of the Society are situated in the north of the Delta in the region most remote from the source of supply at the Barrage where the river water leaves the Nile, it is most satisfactory to have such unquestionable evidence as to such lands being well served in a year of unfavourable conditions as regards water supply.

Next to the arrangements providing for the distribution of water by long interval rotations, and the consequent elimination of the rice crop, the most important measure taken was the passing of a Decree giving the Minister of Public Works power to forbid the planting of the maize crop until such time as he should see fit to allow it. The Decree was issued in March, and was immediately followed by a Ministerial “Arrêté” giving effect to it by forbidding any irrigation for maize sowing until a date to be subsequently fixed. A later circular explained that the “Arrêté” referred to the irrigation of fallow lands, no matter for what crop intended, provided that the system of irrigation employed was the same as that followed as a preparation for the maize sowings, commonly known in Lower Egypt by the expression “Rai Sharaki.” Another circular explained that the prohibition did not apply to irrigation carried on with water derived from wells or from pumps on the river, but only to irrigation with canal water.

This measure of prohibition of maize sowings, though necessary, was exceedingly unpopular, and was freely condemned by irresponsible critics outside the Irrigation Department. The plea that everyone should be allowed to do what he liked with his proper share of water had a plausible ring about it. The practical difficulty was to restrict

each individual to his proper share and no more. If this could have been done, the freedom of the subject to do the wrong thing might have been left to teach him by bitter experience the lesson which would have had the same effect in inducing him to defer his maize sowings as the Decree was meant to have. The difficulty, that was met by the Decree, had been felt as long ago as 1886, in spite of fair summer levels, and before the restoration of the Barrage to efficiency had brought about the recent development of the cotton crop. Mr. Willcocks, in a Paper entitled "Irrigation in Lower in Egypt" and dated 22nd February, 1887 (*Minutes of Proceedings of The Institution of Civil Engineers*, Vol. 88, Part 2) points out that "the regulation of water for summer irrigation is thrown into great confusion, about the 15th of July, by the cultivators on the summer canals taking water for their maize before the flood has really come. Flood irrigation, properly speaking, begins when the water is high enough to flow into the flood canals, which ordinarily takes place about the first week of August." It would therefore appear that, if permission to sow maize from the beginning of August were to be given, the crop would be got in as early as it used to be in pre-Barrage days. But it is said that it is not only the usual date of sowing that has been changed on account of the better supply obtained by the action of the Barrage, but that the crop itself has been changed as a consequence of the opportunity afforded of early sowings. The original crop was known as "durah shami," the crop that has, of late years, supplanted it is known as "durah american." This latter gives a superior yield, but takes about a month more to mature than does the other variety. Hence the concern generally felt when it became known that the sowing would not be allowed till the river had risen sufficiently to give water for both the cotton and maize crops together. Such being the facts, it was obviously advisable to remove the prohibition at as early a date as it was possible to do without running the risk of sacrificing the cotton. On 23rd June the question was discussed, and the gauge readings from Khartoum and the Upper Nile examined. It was decided that the prohibition should be removed universally on 23rd July, and that if, meantime, it was found possible to advance the date in any particular locality or on any single canal, it was to be done. In consequence of this decision maize sowings were permitted in the Mahmudiyah sub-division of the Belerah Province and also on a few canals in Sharkiyah on 12th July; and in the whole of the 2nd Circle from the 20th July. For the remainder of Lower Egypt the date was the 23rd July, as fixed.

On the 23rd July the upstream level at the Barrage had reached R.L. 14.05, and it was thereafter that the new situation created by the construction of the subsidiary Weirs made itself felt. The upstream Barrage level rose rapidly till it reached R.L. 15.50 on 30th July, a higher level than has ever been recorded in July before, and twelve to fifteen days earlier than the usual dates for reaching that level.

Thus, by the operation of the Weirs, though still incomplete, so good a supply was given to the canals at the end of July and in early August that the maize crop was, after all, got into the ground in good time, and an excellent crop was the result. Both cotton and maize crops were saved.

Rotations were still continued, after maize sowings were allowed, to ensure equal distribution from head to tail of canals, as otherwise the tail reaches might have suffered from the heavy abstraction of water for the maize along the upper reaches. But the programme applied was a mild one, of ten days working and ten days stopping in alternation, and only one turn of it was enforced.

Distribution by rotations finally ceased:—

In the 1st Circle on 12th August.

„	„	2nd	„	„	5th	„
„	„	3rd	„	„	11th	„

By the 12th August the rising flood, assisted by the action of the new combination of Barrage and Weirs, had swept away all difficulties and put an end to the trying struggle of four months.

There remains to give an account of the operation of the temporary dams which were made on either branch to exclude the salt water of the Mediterranean from the tail reaches of the river.

The dam on the Damietta Branch was constructed a little north of Damietta in the same place as it was last made in 1889. In that year it cost £E.4,700 to make, maintain and remove. In 1900 it cost £E.4,936. It had to be maintained longer in 1900 than in 1889, as it was made earlier. It would have been better had it been completed even sooner than it was. The fall of the river to low levels was so unprecedentedly early that neither the dam on the Damietta Branch nor that on the Rosetta were completed soon enough. The Damietta Sadd, however, was not much behind time, if at all, as it was completed on the 16th March immediately after the passage of a flush from the Barrage, which was sent down the river to drive the salt water before it back into its proper place beyond the mouth of the river. Up to the end of June the pumps along this branch of the river worked on gaily,

lifting all they could and irrigating without restrictions of any sort. All this time the Barrage gates had been tightly caulked, and it was springs and infiltration alone along the river bed which supplied the pumps with water. But at the end of June the springs appear to have stopped working and with them the pumps, as the bed of the river had now in places become the promenade and carriage drive for the dwellers along its banks. Above Sherbin disconnected pools of water, separated by stretches of sand, represented the river; and below Sherbin, where there was continuous water, it had become too salt to use for irrigation. The crops depending on the river pumps were in imminent danger of perishing. If this were to be, it had been better not to have made the Damietta Sudd at all. Something therefore had to be done, and it was fortunate that, by this time, the lowest level of the river at Cairo (of the 12th June) had been passed and there was news from the Upper Nile of more increase on the way. Still there was little enough to spare. The difficulty was met, however, partly by allowing some of the river pumps to work for short times on the adjacent canals, and partly by discharging about a million cubic metres a day from the Tewfiki-Mansuriyah canal into the river at Mitghamr. This was obtained by reducing the 2nd Circle's share of the river supply by half a million and giving it to the 1st Circle, which had to give it up again to the river at Mitghamr and add half a million more of its own share to it. In doing this there was some risk of creating fresh difficulties elsewhere, but, as the river was on the rise, these difficulties were not felt as fresh ones, but already existing difficulties were no doubt prolonged by this necessity to help the pumps along the river. The dam was maintained till the end of July.

The dam on the Rosetta Branch was made at Mehallet-el-Emir, where it was last constructed in 1894 at a cost of £E.7,799. In 1900 the cost of making, maintaining and removing was £E.9,408. The dam was made annually from 1885 to 1894 at a cost varying from £E.11,384 to £E.7,536 (see page 94 of the 1894 Irrigation Report). The increase in cost of the 1900 dam over that of 1894 is probably due to the fact that the dam was made yearly before 1894 and was not made for six years before 1900, so that more of the base of the preceding dams existed to build on in 1894 than remained in 1900. This dam in 1900 was not closed until the 8th April. Two days afterwards it was breached by heavy storms, but was reclosed finally on 13th April. (This breaching of the dam after closing was probably the origin of a persistent Bourse Report of the time in Alexandria that the Barrage at Cairo had breached and the upstream level had fallen 60 centimetres.

I received two telegrams from Alexandria to enquire). By this time the sea water had invaded the river to a point well above Atfeh, and it was no longer possible to give a flush from the Barrage to drive out the salt water as was done earlier on the Damietta Branch, since the water could not be spared.

The Barrage was tightly closed, but the springs along the Rosetta Branch gave a considerable discharge at Atfeh. By degrees the water became less salt, a head on the sea being kept on the dam and an escape made through it to pass out the discharge due to the springs. On 15th May the water had sweetened enough to allow the Atfeh pumps to commence working, but the quantity added by them to the Mahmudiyah had to be kept down to 300,000 cubic metres a day for fear of making the drinking water of Alexandria too salt for the health of the inhabitants. From 10th June to the middle of July, the pumps lifted a million a day, and during the latter half of July  $1\frac{1}{2}$  millions. They continued to work until 16th August. The cost of working the pumps was £E.5,146: the total quantity lifted was 84,107,480 cubic metres.

Mr. Dupuis has written an interesting Note on the working of the Atfeh pumps and the infiltration discharge of the Rosetta Branch, which I have annexed to this Report. The observations therein recorded will be very valuable when the question of a Barrage on the Rosetta Branch is ripe for settlement.

In order that the 2nd Circle might also reap what advantage it could from the construction of the Mehallet-el-Emir Sadd, six 12-inch pumps were obtained from the Barrage and elsewhere, and were set up at Birimbah close above the sadd. A visit to the sadd on the 18th May convinced me that the pumps would not come into action in their position close to the sadd. It was, therefore, arranged that they should be moved to Kebrit, higher up the river than Atfeh, where the river water was already sweet enough to use. It took a month to make the change, and it was not till 19th June that pumping began. Between that date and 29th July these pumps irrigated at least 5,000 feddans of cotton twice, using the Kodabah canal as the distributing channel. Mr. Verschöyle estimates the cost of this irrigation at P.T.28 a feddan or P.T.14 for each watering, and remarks that "this supply proved a great boon to the district of Foua, where, owing to the declaration of an abnormally low Nile at the beginning of the year, cotton had been substituted for rice."



# RIVER AND CANAL DISCHARGES.

The first application of rotations began on the 4th April. Up to that date it had been found unnecessary to enforce them. The discharge of the river at Cairo on that date was about 28 millions cubic metres per twenty-four hours. The river discharges were found by adding together the discharges of the six Delta canals taking off from the river between Cairo and the Barrage. The registered discharges of 1900, as compared with those of previous years, will appear higher than they actually were; as, in 1900, the mean velocity was taken to be equal to the *maximum* surface velocity  $\times 0\cdot80$ , whereas, in former years, the mean velocity had been taken to be equal to the *mean* surface velocity  $\times 0\cdot80$ .

It was assumed that the pumps on the Damietta Branch added one million cubic metres a day to each of the 1st and 2nd Circle's available supplies, and that the pumps on the Rosetta Branch added one million to the 2nd Circle and half a million to the 3rd, exclusive of the Atfeh station. There was, therefore,  $3\frac{1}{2}$  millions to add to the river discharges to obtain the total available discharge for distribution in the Delta. The method of calculation is shown in the following example, which gives the distribution for 16th April, the date on which rotations began generally, with a river discharge of about 25 millions cubic metres a day:—

## DISTRIBUTION ON THE 16TH APRIL, 1900.

*Upstream Level, Barrage, R.L. 13'28.*

CANAL HEAD LEVELS.				Correct share of river discharge.	Observed discharges.	
Up-stream.	Down-stream.					
R.L.	R.L.					
13 19	12 98	Rayyah Beherah ..	$\frac{1}{2}$ of 28,317,286	— 500,000 =	5,163,457	4,918,277
13 23	13 18	Rayyah Menuthyah.	$\frac{1}{2}$ of ..	— 2,000,000 =	9,326,914	9,114,146
13 25	12 68	Rayyah Tewhki ..	$\frac{1}{10}$ of ..	— $\frac{1}{10}$ of 1,000,000 =	6,454,312	6,836,659
13 45	13 17	Canal Ismailiyah ..	$\frac{1}{10}$ of ..	— $\frac{1}{10}$ of .. =	2,581,729	2,560,965
13 42	13 41	Canal Sharkawiyah	$\frac{1}{10}$ of ..	— $\frac{1}{10}$ of .. =	774,519	889,255
13 36	13 33	Canal Bassusiyah	$\frac{1}{10}$ of ..	— $\frac{1}{10}$ of .. =	516,316	497,984
		Total river discharge ..	...		24,817,286	24,817,286
		Pumps on river ..	...	3,500,000		3,500,000
		Total available for distribution			28,317,286	28,317,286

The following example of the distribution also is added, as it gives the minimum observed discharges of the year. The 12th June was

the date of the real minimum at the Barrage, when the upstream level was R.L. 12.92.

DISTRIBUTION ON THE 13TH JUNE, 1900.

*Upstream Level, Barrage, R.L. 12.95.*

CANAL HEAD LEVELS.						Correct share of river discharge.	Observed discharges.
Up- stream. R.L.	Down- stream R.L.						
12.91	12.26	Rayyah Beherah ...	$\frac{40}{100}$ of 23,476,000—1,300,000		3,395,218	3,438,132	
12.91	12.86	Rayyah Menufiyah ...	$\frac{40}{100}$ of .. —2,000,000		7,390,436	7,062,794	
1ST CIRCLE.							
12.92	12.36	Rayyah Tewfiki . . .	$\frac{45}{100}$ of .. —625,000		5,244,022	5,210,663	
13.14	12.85	Canal Ismailiyah ..	$\frac{15}{100}$ of .. —250,000		5,097,600	2,148,154	
13.04	13.03	Canal Sharkawiyah . .	$\frac{10}{100}$ of .. —75,000		629,283	1,035,167	
13.05	13.02	Canal Bassasiyah ..	$\frac{10}{100}$ of .. —50,000		419,522	281,180	
Total 1st Circle ... ..					8,390,436	8,675,164	
Total river discharge ... ..					19,176,090	19,176,090	
Pumps on river ... ..					4,300,000	4,300,000	
Total available for distribution. .					23,476,090	23,476,990	

On 13th June the Atfeh pumps were lifting about a million cubic metres, but as there were occasional breaks in the uniformity of the quantity pumped for one reason and another, the total available for distribution was credited with only 800,000 cubic metres on this account, and the 3rd Circle debited accordingly. As the other 3rd Circle pumps along the river were assumed to lift 500,000 cubic metres, the pump figure for that Circle was raised to 1,300,000.

The Rayyah Menufiyah and the canals Sharkawiyah and Basusiyah had their Heads fully open throughout the summer, while the other three canals were regulated on to produce the desired discharges. The observed discharges were, it will be seen, not very different from those which the calculations show they should have been. The discharges were taken once a week, the calculations made and the regulation adjusted, if necessary.

The river discharges, obtained by adding together the observed discharges of the above canals, were as follows:—

1901		1901	
11th March...	34,839,761	13th June...	19,176,090 Minimum.
1st April ...	29,340,237	21st June...	20,843,654
16th April ...	24,817,286	30th June...	25,387,199
7th May ...	21,370,458	8th July...	30,047,931
14th May ...	20,515,634	16th July...	34,103,988
30th May ...	20,232,322	23rd July...	42,889,356
7th June ...	20,169,890		

Discharges of the river were taken in Upper Egypt, but I doubt if they are as reliable as those taken on the six Delta canals, as it is more difficult to observe velocities accurately in the river when the discharges are small compared with the width of channel.

The Naga Hamadi measured discharge of 1st June was 17 millions.

At Assiout the Ibrahimiya canal took off at least 3 millions, leaving 14 millions to correspond with the minimum of 19 millions of the above list.

The measurements at Suhag made the minimum about 22 millions. Deducting 3 millions for the Ibrahimiya, this gives 19 millions as the Cairo minimum, which agrees with the Barrage.

At Minia and Fashn the minimum discharges were found to be about 15 millions, which agrees better with Naga Hamadi.

I think the weekly observations made by the Barrage staff the most reliable, as they were made weekly and checked by a careful observer.

The comparison of the river summer gauge readings of 1900 with those of former low years gives curious results. The Aswan gauge readings in May were a metre below the average, and about 40 centimetres below the low summer levels of 1889 and 1890. But both the Wadi-Halfa and the Assiout gauge records show that the 1890 levels were lower than those of 1900. But the existing Halfa gauge was not completed and used until 16th August 1890, so that one feels a want of confidence as to whether the readings previous to that date were referred to the same datum. As regards the Assiout readings, those for 1900 were affected by the obstructions raised in the river by the works in connection with the construction of the Assiout Barrage.

That there was some temporary cause producing high readings on the Asyut gauge is shown by a comparison of the 1900 and 1901 gauge readings at Asyut with those of the Suhag and Minia gauges, the next above and below Asyut. The comparison is made in the following statement:—

DIFFERENCES IN RIVER LEVELS OF 1900 AND 1901.

	1st February	15th February	1st March	5th March	15th March	19th March
Suhag ... ..	89	71	65	58	53	49
Asyut ... ..	33	43	30	13	03	00
Minia ... ..	106	68	61	57	52	46

But we have a reliable means of comparison between 1890 and 1900 in the Barrage records. In 1890, as in 1900, the Barrage gates were entirely closed and caulked as tight as possible, and the whole river discharge was forced into the Delta canals. In 1890 the upstream level at the Barrage fell to its minimum of R.L. 12·89 on the 15th to 17th June, with the heads of the six canals fully open. In 1900 the level fell to R.L. 12·92 on the 12th June when three of the six canals were being regulated on. If all the heads had been fully open on that date in 1900, the upstream level would have fallen to some point between R.L. 12·40 and R.L. 12·92, probably to R.L. 12·65 or 12·60, or to a level about 25 centimetres lower than the minimum of 1890.

The lowest level at Aswan of the 1890 record is 10 kirats (R.L. 84·40) on 28th May. The lowest level of 1900 is—4 kirats (R.L. 84·07) of the 15th, 16th and 26th May. The mean low water at Aswan is R.L. 85·00 as calculated from twenty years' observations. The river there in 1900 fell below that level on 9th February and remained below it till the 27th June, a period of 138 days, that is for the *whole* of the cotton crop season preceding the flood! The lowest level reached, namely R.L. 84·07, was 93 centimetres below mean low water level. The 1890 levels at Aswan were eighty-two days below the mean low water level of R.L. 85·00.\*

On page 25 of the Irrigation Report for 1890, the minimum river discharge at Cairo, as taken on 16th and 17th June by addition of the six measured canal discharges, is given as 20,000,000. The minimum of 1900 was a million less.

On page 10 of the Irrigation Report for 1899 the minimum river discharge at Cairo, by deduction and assumption, was reckoned to be 17,350,000 cubic metres for that year. This was obtained by adding the discharges of the 7th July, deduced from the measured discharges of the 16th May of the two branches of the Nile and the Menutiya canal, and assuming 3 millions to be the aggregate discharge of the three canals nearer Cairo. This method of arriving at the minimum discharge cannot be expected to give an accurate result.

The following Table makes a comparison of bad summer Niles from 1870 onwards. The mean low water at Aswan is taken to be R.L. 85·00.

\* See Appendix M. Note on Comparison of the Discharges of 1889 and 1900.

YEAR.	MINIMUM READINGS			Date of fall below M.L.W.	Date of rise above M.L.W.	Number of days below M.L.W.
	Date.	Pic. Kinds	Reduced to mean sea.			
1871	16th June.... ..	1 13	84.99	16th June.	17th June.	1
1872	24th and 25th May...	1 0	84.70	5th April.	16th June.	72
1873	3rd June. ... ..	0 21	84.63	2nd May.	11th June.	41
1874	26th to 29th May. ...	0 8	84.34	25th March.	3rd June.	70
1875	23rd May. ... ..	1 6	84.83	14th May.	28th May. /	22
				15th June.	23rd June. /	
1878	7th to 9th June. ...	0 6	84.29	25th March.	27th June.	94
1881	13th and 14th May...	1 13	84.99	13th May.	15th May.	2
1882	21st and 22nd June...	0 13	84.45	19th April.	27th June.	69
1885	20th and 21st June...	0 18	84.56	28th April.	25th June.	58
1886	3rd June. ... ..	1 11	84.94	28th May.	6th June.	9
1887	5th May. ... ..	1 12	84.97	3rd May.	8th May.	5
1888	4th and 5th June. ...	1 10	84.92	30th May.	11th June.	12
1889	4th June. ... ..	0 11	84.40	12th May.	3rd June.	49
1890	28th May. ... ..	0 10	84.37	1st April.	22nd June.	82
1891	16th to 18th May. ...	1 4	84.79	18th April.	19th April. /	33
				23rd April.	25th May. /	
1892	4th to 6th June. ...	0 9	84.36	13th April.	28th June.	76
1894	8th and 9th May. ...	1 12	84.97	7th May.	11st May.	4
1898	22nd and 23rd June.	1 2	84.74	4th May.	28th June.	55
1900	15th, 16th & 26th May.	0 4 (below 2.20)	84.07	9th February.	27th June.	138

NOTE.—The minimum gauge reading registered previous to 1900 was R.L. 84.29, at 1878. The readings of 1900 were below this minimum for 63 days from 31st March to 1st June inclusive.

## DUTY OF WATER.

In calculating the duty of water in previous years, the contribution of the pumps along the river have been neglected, with the result that a somewhat higher duty has been obtained from the calculations than was correct. I propose now to take account of the pumps in calculating the duty for 1900. On p. 151 of the report for 1898, the taxed areas of the different Provinces is given. I do not suppose they have

changed materially since. The calculation must be made by Circles, as the water supply is subdivided by Circles and not by Provinces.

	Taxed area	Assuming $\frac{1}{3}$ of taxed area to be under crop.	Assuming $\frac{2}{5}$ of taxed area to be under crop.	May 7th to June 21st summer average discharge cubic metres per 24 hours.
1st Circle ... ..	feddans, 1,232,448 cubic metres.	feddans, 410,816 cubic metres.	feddans, 492,979 cubic metres.	9,764,534
Duty per feddan.. ...	7.92	23.77	19.81	
2nd Circle ... ..	feddans, 1,329,997 cubic metres.	feddans, 443,332 cubic metres.	feddans, 531,999 cubic metres.	9,425,904
Duty per feddan.. ...	7.09	21.26	17.72	
3rd Circle (Behera) ...	feddans, 627,573 cubic metres.	feddans, 209,191 cubic metres.	feddans, 251,029 cubic metres.	4,963,204
Duty per feddan.. ...	7.91	23.72	19.77	
Whole of Lower Egypt	feddans, 3,190,018 cubic metres.	feddans, 1,063,339 cubic metres.	feddans, 1,276,007 cubic metres.	24,153,642
Duty per feddan.. ...	7.57	22.71	18.09	

It is evident from the foregoing figures that the 2nd Circle had, proportionately to its taxed area, the shortest supply; and, therefore, the calculation of the duty got out of the water in this Circle during the summer of 1900 might be expected to give a maximum. Mr. Verschoyle has carefully worked out the duty from crop areas given to him by the Finance Ministry, and has obtained the figure of 19.60 cubic metres as the general duty for summer crops other than rice. This figure is intermediate to the foregoing figures obtained by me on the assumption that one-third and two-fifths of the taxed area was the area under crop.

The areas of crop in the 2nd Circle, used by Mr. Verschoyle in his calculations are:—

Rice... .. 13,819 feddans.  
Other Sefi crops ... .. 510,767 ..

Allowing about 2 millions cubic metres for lifting machines on the river, and then deducting  $(13,819 \times 40) = 452,760$  cubic metres for

rice, the mean daily discharge used in irrigating other Sefi crops is found to be 9,989,916 cubic metres.

The duty per feddan of crop is then—

$$\frac{9,989,616}{510,767} = 19.60 \text{ cubic metres.}$$

It must be noted that Mr. Verschoyle calculates with the mean of the discharges of the period between 1st April and 15th July; not with the mean discharge of the period of shortest supply, which I have taken as extending from 7th May to 21st June.

To enable a comparison of the duty thus found to be made with the duty of previous years, Mr. Verschoyle has corrected the figures of former Reports allowing for the 2 millions cubic metres added to the available discharge by lifting machines on the river. The resulting figures, given in the table below, apply to the 2nd Circle, which has always had less than its proper share of the river discharge and has, therefore, had to extract the highest duty out of its summer supply.

YEAR.	Area under rice.	Area under ordinary Sefi crop.	General duty as given in former annual Reports.	Corrected "general" duty after adding 2 millions cubic metres to the R. Menefiyah daily discharge.
1895	62,760	423,096	24.29	29.00
1896	39,193	438,269	23.88	28.43
1897	56,585	482,226	20.35	24.49
1898	38,232	458,170	19.38	23.74
1899	33,892	512,175	23.01	26.91
1900	13,819	510,767	—	19.60

As Mr. Verschoyle obtains his "duty" from the mean of the discharges of the period from 1st April to 15th July, it represents the *mean* summer duty and not the maximum duty. During this period, water was given for 14 days without rotations, say, at the rate of one watering in 15 days, for 33 days at one in 18, for 18 days at one in 24, and for 41 days at one in 28. The mean interval between waterings was, therefore,  $22\frac{1}{2}$  days. It is now the general opinion that one watering in 21 days is a fully sufficient supply for producing a maximum crop of cotton so far as irrigation is the determining factor. Accepting this as correct, we can now deduce the figure that may be considered the *correct* one to represent the quantity of water that it is desirable to allow per feddan of cotton in our calculations of any project for its irrigation. As 19.60 cubic metres per day per feddan was

sufficient to allow a watering every  $22\frac{1}{2}$  days, the quantity required to give a watering every 21 days will be

$$\frac{22.50 \times 1960}{21} = 21 \text{ cubic metres.}$$

Again, if Mr. Verschoye had calculated with the discharges of the period of shortest supply from 7th May to 21st June, during which the Rayah Menufiyah mean discharge was 7,600,000 cubic metres, the maximum "duty" for the time of shortest supply would have worked out as follows. Adding 1,691,500 cubic metres for the river machines after deducting for the irrigation of rice, the available discharge becomes 9,291,520. The pumps at Kebrit did not begin to work till 19th June, so their discharge is not included.

$$\text{Maximum duty} = \frac{9,291,520}{510,767} = 18.19 \text{ cubic metres.}$$

During this period water was given for 11 days at the rate of one watering in 18 days, for 18 days at one in 24, and for 17 days at one in 28. The mean rate was, therefore, one in 24, and the allowance required to give a watering in 21 days would be

$$\frac{24 \times 18.19}{21} = 20.90 \text{ cubic metres.}$$

Mr. Langley calculates his general duty for the 1st Circle to be 17.70 cubic metres, working with an available discharge of 9,638,204 cubic metres, and the following figures for crops:—

Rice...	...	...	...	...	...	...	...	...	10,918 feddans.
Other Sefi crops	...	...	...	...	...	...	...	...	517,815 ..

But there is included in this area 37,151 feddans of summer durah some of which probably belongs to a later period of the summer. Mr. Langley further thinks the rice area excessive. It will be better, therefore, to exclude half the durah area, though accepting the rice as correct. (All the Sefi durah and rice, it may be noted, must have been irrigated by pumps direct from the river.) The crop areas will then be

Rice...	...	...	...	...	...	...	...	...	10,918 feddans.
Other Sefi crops	...	...	...	...	...	...	...	...	499,280 ..

The mean total discharge of the 1st Circle for the period from 7th May to 21st June was 8,870,896 cubic metres, to which one million is to be added for river pumps. Deducting  $(10,918 \times 40) = 436,720$  for rice, the available discharge for cotton is 9,434,176, and the "general duty"

$$= \frac{9,434,176}{499,280} = 18.90$$



During this period one watering was given in a mean period of 24·83 days. The allowance required to give a watering in twenty-one days, would, therefore, be

$$= \frac{18\cdot90 + 24\cdot83}{21} = 22\cdot35 \text{ cubic metres.}$$

The following is the calculation made by Mr. Dupuis of the “duty” of water in the 3rd Circle:—

“The areas of the various crops were given as follows by the Finance Department:—

Nili and Sefi rice	...	...	...	...	...	...	...	...	15,018 feddams.
Other Sefi crops	...	...	...	...	...	...	...	...	230,261 „

“Of the rice it is probably fairly correct to assume one-third as Sefi, and this compares well with the other Circles; the area of Sefi rice is then 5,006 feddams.

“Considering the period, 7th May to 21st June, the following discharge was available for the crops:—

	Cubic metres per day.
Ravah Behera (mean of nine observations by Barrage Staff).	4,056,758
Atfeh Pumps (approximate actual mean output). ... ..	443,261
Private pumps on the river (estimated) ... ..	500,000
Total available discharge ... ..	5,000,019
Deduct rice allowance (5006 × 40) ... ..	200,240
Supply available for cotton and other Sefi crops ... ..	4,799,779

“4,799,779 cubic metres per day for 230,271 feddams of cotton and other Sefi crops gives a duty of

20·0 cubic metres per feddan per day.

“During this period the Mahmudieh Division (approximately one-third of the Province) was getting one watering every twenty days; and, for rather more than half the time, the remainder of the Province was getting the same; and the mean rotation period for the whole Province, worked out proportionately, comes to almost exactly twenty-one days.

“Therefore, as regards the 3rd Circle, it was found possible to give one watering every twenty-one days with a discharge of under 21 cubic metres per feddan of Sefi crops other than rice.”

The results of the foregoing calculations are collected below :—

CIRCLE.	AREA OF CROPS.		General duty.	Allowance per feddan of Sefi crop other than rice, required to give a watering every 21 days, deduced from the preceding column.	
	Rice.	Other Sefi crops.	Cubic metres per feddan.		
	feddans.	feddans.			
<i>1st Circle.</i>			Maximum.		
Inspector's figures... ..	10,918	517,855	17.70	20.93	} mean 21.20
Inspector-General of Irrigations figures... ..	10,918	499,280	18.90	22.35	
<i>2nd Circle.</i>			Mean.		
Inspector's figures... ..	13,819	510,767	19.60	21.00	
Inspector-General of Irrigation's figures... ..	13,819	510,767	Maximum. 18.19	20.90	}
<i>3rd Circle.</i>					
Inspector's figures... ..	5,006	230,271	20.80	20.80	

The figures obtained support the conclusion I drew in last year's Report, namely, that "30 cubic metres a feddan is *at least* sufficient, and that even with an allowance of 25 cubic metres per feddan of Sefi crop other than rice, full crops can be raised."

It would seem that 21 to 22 cubic metres is sufficient allowance to make at the head of the main canals, as the foregoing calculations are based on the discharges measured at the heads. It may, therefore, be laid down that, assuming that what suits cotton best is one watering every twenty-one days, the mean discharge at the head of the canal should be at the rate of 22 cubic metres per feddan of cotton, or summer crop other than rice. If we can give this allowance, we can secure full crops, weather permitting.

Mr. Willcocks, in the second edition of "Egyptian Irrigation," p. 365, states that "a canal in summer should discharge 22 cubic metres per 24 hours per acre of cotton to be irrigated"; which the calculations, now made, show to be absolutely correct.

We have been accustomed to assume that a feddan of summer crop requires a water supply at the mean rate of 24 cubic metres per day. The adoption of this figure as the basis of our calculations seems then to be on the safe side. But it was until lately assumed that one-third only of the cultivable area was under summer crop at a time, and hence 8 cubic metres a feddan on the whole cultivable area was the figure used to calculate the supply required in summer. But about two-fifths

is habitually planted, and 9 cubic metres a feddan would be a more correct figure to adopt, so that the result of calculations of the quantity of water required, based on the cultivable area, should give the same amount as calculations made from the crop area at 22 cubic metres a feddan.

The allowance of 22 cubic metres per feddan of crop, or 9 cubic metres per feddan of the cultivable area commanded only makes provision for cotton or other summer crops which are irrigated in a similar manner to cotton. The quantity of water that is required for the irrigation of the rice crop must be added to obtain the total required. Now, rice requires an indefinite quantity of water, assumed in our calculations of duty to be 40 cubic metres a feddan. But actually the crop takes any quantity it can get from 40 cubic metres a feddan upwards. And not only does it take a large quantity of water, but it requires it at short intervals, and at least one watering in eleven days must be given. Now, if summer rice has to be given water under these conditions from the tail reaches of a system of canals, it is impossible to work a programme of rotations in the upper reaches to give cotton only one watering in twenty-one days, and the whole economical scheme of rotations, which is adapted to the cotton crop, is upset to meet the extravagant demands of a crop of little value. Consequently in 1900, when the water available was unprecedentedly little, the rice crop was not provided for in the scheme of water distribution.

Nor does it seem that the sacrifice of rice to the better paying crop is a serious one. Two kinds of rice are grown in the country, distinguished as "Sultani" and "Sabaini." Mr. Willecocks in "Egyptian Irrigation" tells us the following about the two varieties:—

"Sultani Rice is sown from the 5th May to the 5th June. The harvest is reaped during November. This crop needs as a minimum 40 cubic metres per acre per day, and in flood receives as much as the drains can possibly carry away.

"Sabaini is sown as soon as the flood arrives, about the 5th August, and is sown up to the 5th September. It is reaped at the same time as the Sultani, and receives as much water as the drains can dispose of."

As there is no great difficulty in providing water for Sultani rice, I have sought for reasons for and against the substitution of Sabaini for it. I am told that, though the price of "Sabaini" is lower than "Sultani," the yield is fuller, and so the value of the crop per feddan is about the same; and, provided Sabaini can be in the ground by the 20th August, it gives a full crop. If this condition can be fulfilled, why then plant Sultani?

The sole reason, it appears; why Sabaini cannot supplant Sultani entirely, is this—that there are some classes of land which are so bad, agriculturally speaking, that they will not grow Sabaini: on “Siblakh” land Sultani rice alone can be raised. Sultani, the slow growing crop, probably draws its nourishment from the water to a greater extent and from the land to a less extent than does the more rapidly maturing Sabaini; and hence this distinction between them as regards the quality of land on which they can be raised. Another argument is used in defence of the Sultani crop, which is, not that the crop is valuable, but that the process of irrigating it with an abundant supply of water for a long time has, as its most important results, the improvement of the bad land by the washing out of the salts. But in a year of short summer supply, it is precisely this need which makes the crop a difficulty; and a time of scarcity of water is not the time to choose for reclaiming land by heavy washing.

On the other hand it is stated that if the Sabaini crop can be got in early (before 20th August), it gives a full crop. In 1900, owing to the early increase of the canal discharges by the operation of the weirs, the crop did well. In Gharbiyah an area of 46,083 feddans was planted with Sabaini. The weirs will be completely finished before July, 1901, and, consequently, their action in advancing the date of plentiful supplies in the canals is assured for the future. There is also another work which, when complete, will affect this question. The Ziftah Barrage will bring us “nearer our work” as regards the early supply of water for Sabaini rice. The greater part of the rice regions of Gharbiyah and Dakahliyah will be served by canals taking off from above the Ziftah Barrage, and, almost immediately after the flood begins to flow down the Damietta Branch, these canals will receive full supply. Such being the present and future situation, I consider it would be in the interests of Lower Egypt, if Sultani rice cultivation were to be confined to those lands which cannot grow Sabaini by reason of their inferior quality. If this limitation were observed, the summer rice area would be so small that it might be possible to provide for its irrigation with an allowance of 22 cubic metres per feddan of summer crop without distinction: as it appears that, though a watering every twenty-one days is desirable for cotton planted in the south of the Delta, the crops raised in the moister climate and lands in the north do not require such frequent waterings and will suffer no injury if the waterings are given once in twenty-four days, or even once in twenty-eight days.

I have discussed this question of the “duty” of water at length, as it

is important that our conclusions on this point should be correct, since all canal projects must depend upon it. There will, no doubt, be new reservoir projects to follow on the completion of the Aswân reservoir, and it is necessary to be able to state with confidence what quantity of water is required to be stored to provide for the fullest expansion of Egypt that it is possible to bring about by a scientific manipulation of the Nile discharges.

#### PRIVATE IRRIGATION PUMPS IN THE 2ND CIRCLE.

In last year's Report I pointed out that Mr. Verschoye, as Inspector of the 2nd Circle, was making a great effort to regularise matters regarding the lifting machines in the 2nd Circle. He has drawn up the Table given in Appendix L, which is, at any rate for the present, accepted as the basis on which future licences will be granted. He has commenced to give all lifting machines a serial number, and to prepare registers giving all necessary information as to ownership and other details in the case of each machine: he has, during 1899 and 1900, succeeded in reducing the sizes of 15 licenced pumps, which were larger than they should have been, the aggregate reduction in lifting power being equivalent to 32 8-inch pumps. This is an important step in the direction of a more just distribution of the available water supply. There actually exist in the 2nd Circle 282 fixed engines and 1,392 locomobiles. Licences exist for 16 more fixed engines and 45 locomobiles, which have either not been erected or have fallen out of use. Of those existing, 236 fixed engines and 1,232 locomobiles are in order as regards their licences: the remainder are under investigation. It was high time that this matter should receive attention when Mr. Verschoye took it up, and the energy he has expended on it (and the expenditure of energy required and the determination necessary are great) has been power well applied.

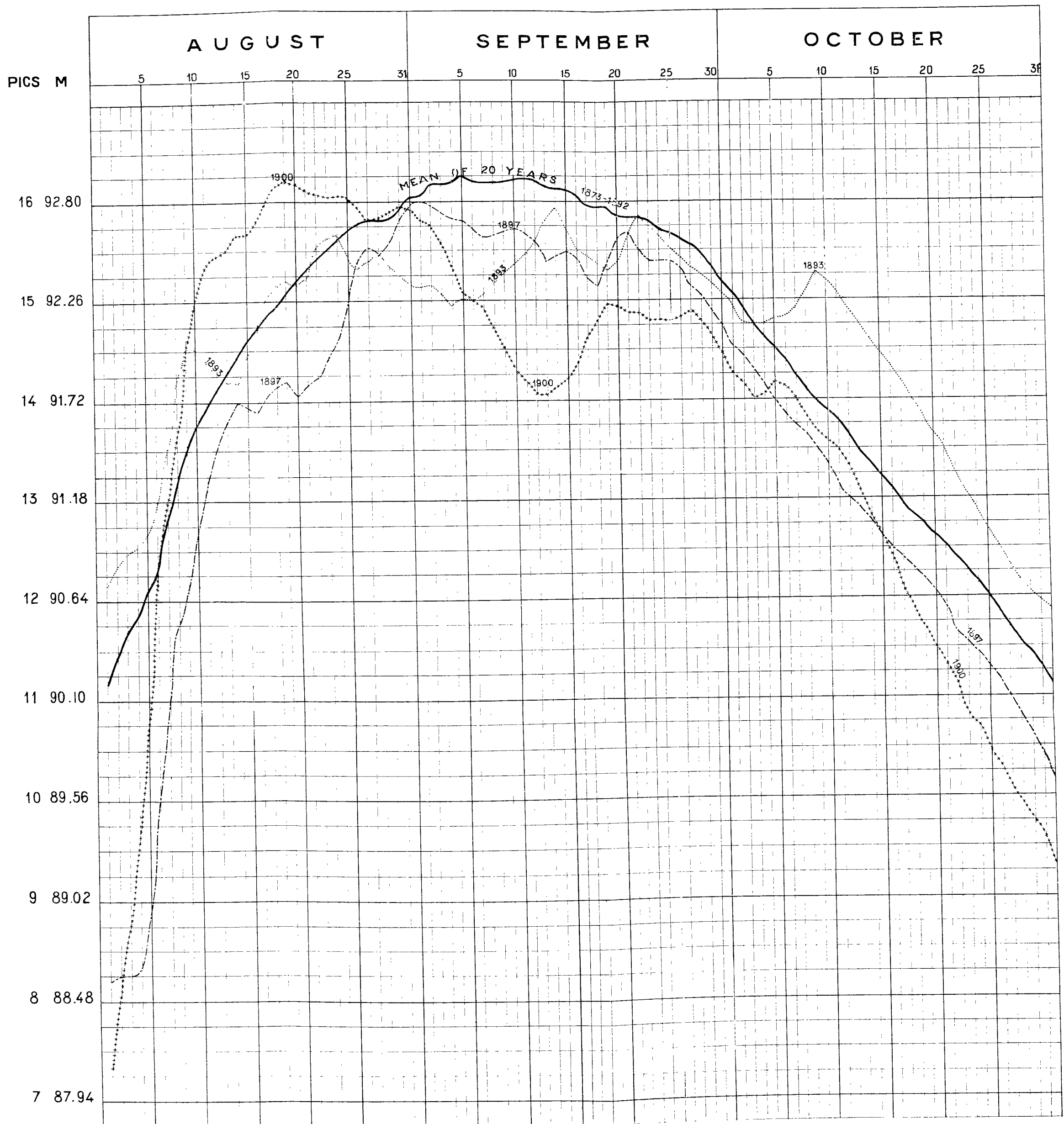
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## CHAPTER II.

### FLOOD SEASON.

The 1900 flood was one of low levels. At first the rise was rapid, and the Barrage was fully opened by 13th August. The August levels were above the average. But in September this was reversed, as is shown by the accompanying diagram in which are given the flood

# GAUGE AT ASWAN





curves for 1893, 1897 and 1900, years of approximately similar floods. The maximum of the 1900 flood was 16 pics 5 kirats, reached on 19th August. Lower Egypt is not much affected by the deficiency of floods, unless it is extreme, as in 1859. The river discharge was sufficient to produce a level of R.L. 15.76 at the Barrage, with all its gates open, on the 14th August. The maximum level at the Barrage was R.L. 16.40 of the 2nd and 3rd September. Between 15th August and 26th October the Barrage upstream levels varied between R.L. 15.88 and R.L. 16.40, which are sufficiently good levels to supply Lower Egypt. By the 6th November the level had fallen to R.L. 15.24, while there was still a demand for higher levels for the winter cropping on the high lands near the Barrage. The level was, therefore, raised by regulation on the Barrage to R.L. 15.59 and kept at that level till 20th November; after which it was allowed to fall gradually.

Sefi Irrigation had to be resorted to in place of flow at an earlier date than would have been the case, had the flood levels been good ones. But the good levels produced above the Barrage in early August by the combined action of Barrage and Weirs, and those again produced in November by regulation on the Barrage, gave such supplies to the canals that Lower Egypt scarcely felt that the flood was short. The late-sown maize along the inside of the Nile banks benefitted from the lowness of the river, as there was no infiltration to do it harm.

The maximum levels of 1900 on the Rodah gauge were reached on the 3rd September and 21st October. The level of 3rd September was 20 pics 14 kirats and was the maximum of the natural flood: the level of 21st October was 21 pics and was the top of the artificial flood produced by the discharge of the basins.

The basin irrigation of Gizeh Province was successfully conducted. The new improvements, carried out before the flood, proved of great benefit on both sides of the river. The head reaches of the Khashab Canal, on which East Gizeh used to depend entirely for its supply, were well cleared, and a new feeder Head from the river was made at Gamazah, consequently the supply was much improved. At the south end of East Gizeh there was a comparatively small area which the water could not reach, and much of this was put under "Nabari" crop. The whole of this unflooded area (including that planted with Nabari) was estimated at 1,000 feddans, but the greater part of this area is what the Finance Ministry classify as "half Nabari."

The complicated final operation of "Sarf," connected with the cutting of the Nikla Sadd, was more successfully conducted even than in 1899 in consequence of the experience gained in that year of low



Nile. A regulator is about to be built across the Rayyah Beherah close to Niklah, which will simplify this operation and remove the risks at present attending it, besides bringing other advantages.

As in 1899, expenditure was incurred in surrounding high areas outside the Nile banks with temporary banks and in digging temporary channels to secure their irrigation. On this account £E.31 was spent in the 1st Circle, £E.465 in the 2nd Circle and £E.1,696 in the 3rd.

Flood  
Watchmen.

The number of flood watchmen called out were naturally more than those of the year before; they were even more than those of 1897. The explanation of this is that the level (18 pics on the Rodah gauge), on the river reaching which watchmen are called out, was attained in 1900 on 15th August; whereas that level was not reached till 30th August in 1897. Again, in 1900, 20 pics was reached on 23rd August, and a high flood was, therefore, anticipated; whereas 20 pics was not reached in 1897 until 19th October, when there could be no longer any expectation of a high flood. Had it been known in 1900 that the Upper Egypt basin discharge was not going to produce an artificial wave, such as it caused in 1893 and 1897, the watchmen might have been dismissed earlier. The larger numbers were due to higher levels having been expected than actually obtained.

The total numbers, reduced to their equivalents for a period of 100 days are as given below with the numbers of the previous similar years, 1893 and 1897, also given for comparison, and also the maximum level reached at Aswan, and the average level of the fifty days from 12th August to 30th September. The accompanying diagram affords a ready means of comparing the nature of the flood in the three years:—

YEAR.	Maximum H.F.L.	Average W.L. of 50 days of flood	Number of watchmen for 100 days.			
			1st Circle	2nd Circle	3rd Circle	Total.
1893	P. K. 15 22 (14th September).	P K 15 6	3,063	3,944	3,335	10,342
1897	16 0 (31st August)	15 3	183	724	1,525	2,432
1900	16 5 (19th August).	15 5	249	1,531	1,730	3,510

#### GAUGES ON LAKE VICTORIA NYANZA.

We have now a continuous record of readings of gauges on opposite sides of Lake Victoria Nyanza, from Ports Victoria and Ugowe on

the east, and Port Alice on the west shore. We have also a register of gauge-readings from Lubwas in Usoga near the north outlet to the lake. The record is for the period between 1st September, 1898, and 31st October, 1900. The register shows that the fluctuation of the lake level for that period was 2 ft. 1 in. at Port Alice, and 2 ft. 7 in. on the opposite shore. The lowest level of the record is that of the latest date for which the readings have been received, namely 31st October, 1900. It seems that October and November are the months of lowest lake levels. The steady fall of the lake seems to be indicated by the following readings:—

DATE OF READINGS.	Port Alice (Entebbe).	Port Victoria and Ugowe.	Lubwas (Usoga).
1st October, 1898... ..	3 ft. 2 in.	3 ft. 2½ in.	3 ft. 1½ in.
1st October, 1899... ..	2 ft. 6½ in.	2 ft. 2 in.	1 ft. 5 in.
1st October, 1900... ..	1 ft. 7 in.	1 ft. 1 in.	1 ft. 0 in.

Whether the levels of the Nile in Egypt during the summer of 1901 will likewise be lower than those of the year before, or not, will be known before this Report is published.

### CHAPTER III.

#### PUMPING STATIONS.

There are three Government pumping stations in Lower Egypt, at Mex, at Atfeh and at Kassassin. The Mex and Kassassin pumps work in the service of drainage, the Atfeh pumps in the service of irrigation.

The Kassassin pumping station provides for the drainage of the Kassassin. Wadi Tumilat exclusively, and therefore, reference to it will be made in Chapter VII which deals with the Wadi Estate. The cost of working this was £E.3,230, but it is not included in the expenditure statement given at the beginning of Chapter VI, as it was paid for from the revenue of the Wadi.

The enlargement of the Mex pumping station was complete, so far Mex. as the erection of the machinery was concerned, before the beginning

of the 1899-1900 season. The station now consists of five Farcot direct-acting centrifugal pumps and two 48-inch centrifugal Gwynne pumps, capable of lifting a maximum of 3 million cubic metres in 24 hours.

Though the erection of the machinery was complete, the whole installation was hardly in working order, so that not more than three out of the five Farcot pumps was ever at work at one time, and the maximum quantity of water lifted in any one day was 2,372,263 cubic metres.

The pumps worked between 4th November, 1899, and 4th April, 1900, and lifted in that time 202,987,741 cubic metres. This is considerably less than the quantity lifted the previous season, namely 284,896,064 cubic metres. The decrease is due to the low flood levels of 1899 and to the light rainfall of the following winter. So great an effect have these two natural causes on the level of the lake that, though the quantity pumped was less than it was in any of the three preceding seasons, the maximum level reached by the lake was  $-2\cdot29$ , the lowest since 1892. The following are the rules laid down to determine when the pumps are to commence working and when they should stop, the dates and the number of pumps depending on the levels reached by the rising or falling lake. These rules were observed during the season 1900-1901, following the season belonging to this Report:—

Lake level.		Number of pumps to be worked.
Above ...	$-2\cdot50$	Whole installation.
Between...	$-2\cdot50$ and $-2\cdot60$	Two Gwynnes and two Farcots.
.. ...	$-2\cdot60$ and $-2\cdot70$	Two Gwynnes only.
Below ...	$-2\cdot70$	None.

In future these rules will apply up to the end of February ; but, if during the winter, the lake level, in spite of the pumping, rises higher than  $-2\cdot40$ , the levels given by these rules are to be increased by the amount that the maximum level may exceed  $-2\cdot40$  ; as, once the land has been inundated, there is nothing to be gained from keeping the lake at lower levels ; whereas the higher the level, the greater the surface of the lake, and therefore the greater the evaporation and the less the balance to be raised by the pumps.

The total expenditure on the season's working (1st July, 1899, to 30th June, 1900) was £E.9391,\* and the cost of lifting one million cubic metres £E.46.261. The increase in this rate is chiefly due to

\* The expenditure during the 12 months on 1900 was £E.9,631. This figure includes part of two pumping seasons.

the increase in the price of coal, which averaged £E.1.678 per ton as against £E.1.237 of the previous season. But some of it is due to expenditure connected with finishing the new installation, charged as working expenditure: also to the reduction in the quantity pumped, as the establishment expenses, being constant, are proportionately greater the less the quantity pumped.

The following tables give figures of quantities pumped, cost, rainfall and lake levels for the past few years:—

SEASON	Quantity of water pumped.	Cost	Rate per million cubic metres
		£E.	£E.
1895-1896 ... ..	175,078,166	7,588	43'004
1896-1897 ... ..	216,994,810	8,068	37'000
1897-1898 ... ..	227,429,530	8,675	38'000
1898-1899 ... ..	284,896,064	8,378	30'000
1899-1900 ... ..	202,987,741	9,391	46'261

#### RAINFALL AND LAKE LEVELS.

SEASON.	Rainfall.	Maximum level.	Date of maximum.	Minimum level in succeeding summer.	Date of minimum.
1894-1895 ... ..	6'04	-2'13	17th March.	-3'28	24th August.
1895-1896 ... ..	10'45	-2'15	17th March.	-3'15	22nd August.
1896-1897 ... ..	8'53	-2'03	7th Jan. 23rd Jan. & 13th March.	-2'92	11th Sept.
1897-1898 ... ..	13'94	-2'17	18th Feb.	-3'20	27th August.
1898-1899 ... ..	11'88	-1'95	27th Jan.	-3'26	16th Sept.
1899-1900 ... ..	8'28	-2'29		-3'29	11th August.

The new additions made to the station were charged to New Drainage Works. They were the following:—

- (1) A brick chimney.
- (2) Re-arrangement of condensing plant of the Farecot pumps.
- (3) Pavement of flag stones to the new boiler house.
- (4) Improvement of the inlet channel between lake and pumps.

The new bridge over the inlet channel on the line of the Mex causeway has been put in hand.

The brick chimney has been well built and is a satisfactory construction.

By the re-arrangement of the condensing plant, fresh water only is used in the condensers and returned through cooling tubes to a small storage tank near the pumps. By these arrangements a limited quantity of fresh water is used over and over again, thereby effecting a great economy and overcoming the difficulty as regards the increase of the fresh water supply, necessitated by the enlargement of the station, without increasing the size of the supply pipe or constructing a special fresh water canal from the Mahmudiya as originally suggested. The contrivance answers admirably with only two or three pumps at work, but probably an increase in the number or length of the cooling tubes will be necessary to perfect the system, an addition which can be made without much difficulty.

Atfeh.

As has been told in Chapter I, the Atfeh pumps were worked in the summer to add to the supply of the Mahmudiya canal by lifting water from the river. The expenditure on this station was met from three sources. The ordinary up-keep of the station, including the establishment, was charged to the ordinary Budget and amounted to £E.495. The cost of pumping, £E.5,148, was met chiefly by a special grant made by the Caisse, £E.193 of the amount only being contributed by the Kom-el-Akhdar Company according to an agreement made with it in the interests of its Estate. The performances of this station have been described in Chapter I, and further details are given in the annex to this Report.

The pumps are not well adapted to the high lift under which they had to work, and alterations will have to be made to adapt them. The strain of working the pumps at their extreme lift, after they had been lying unused for so many years, has been so great that expensive alterations and repairs will be necessitated in 1901. The assistance given by this station at the end of the summer in adding to our available water supply for irrigation was of great value.

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## CHAPTER IV.

### NEW DRAINAGE WORKS AND IRRIGATION IMPROVEMENTS.

The Commissioners of the Caisse de la Dette granted liberal sums for expenditure during 1900 on New Drainage Works and Irrigation Improvements. Lower Egypt's share of these grants was £E.180,000, which amount was distributed as shewn in the following statement.

The unspent balances of the year before, still available for further expenditure, are also given.

CAISSE CREDITS.

	1st Circle.	2nd Circle.	3rd Circle.	TOTALS.
	£E.	£E.	£E.	£E.
Unspent balances from 1899 ... ..	6,085	4,118	4,807	15,010
Caisse allotments 1900 ... ..	40,000	60,000	80,000	180,000
Total ... ..	46,085	64,118	84,807	195,010

The expenditure against these allotments, and the further expenditure on New Drainage Works and Irrigation Improvements charged against the Regular Budget, are given by the following figures:—

EXPENDITURE.	NEW DRAINAGE AND IRRIGATION IMPROVEMENTS.				
	1st Circle.	2nd Circle.	3rd Circle.	Barrage.	TOTAL.
	£E.	£E.	£E.	£E.	£E.
<i>New Drainage Works.</i>					
Caisse { Staff ... ..	2,129	2,308	4,164	—	8,601
{ Works ... ..	41,900	60,542	44,694	—	147,136
Budget... ..	1,744	6,586	2,940	—	11,270
Total Drainage ... ..	45,773	69,436	51,798	—	167,007
<i>Irrigation Improvements.</i>					
Caisse ... ..	—	—	12,492	—	12,492
Budget... ..	3,948	—	20,279	5,029	29,256
Total Irrigation ... ..	3,948	—	32,271	5,029	41,748
Total New Drainage and Irrigation Improvements... ..	49,721	69,436	84,569	5,029	208,755
Caisse Allotments remaining unspent and carried on to 1900...	2,056	1,268	23,457	—	26,781

NEW AND REMODELLED DRAINAGE WORKS.

The Table which follows gives figures recording the progress made and the expenditure incurred on Drainage Works for the last four years. During 1900 an aggregate length of 185½ kilometres of new drains were dug, and 110½ kilometres of previously existing drains remodelled. The total expenditure during the year on these works was £E.167,443. The works include earthwork by hand and dredging, and all descriptions of masonry and timber work connected with the drains.

STATEMENT OF LENGTHS OF DRAINS DUG OR REMODELLED AND YEAR'S EXPENDITURE ON DRAINAGE WORKS.

	1ST CIRCLE.					2ND CIRCLE.					3RD CIRCLE.					TOTALS.				
	1897.	1898.	1899.	1900.	Totals.	1897.	1898.	1899.	1900.	Totals.	1897.	1898.	1899.	1900.	Totals.	1897.	1898.	1899.	1900.	Totals.
	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.	Kilom.
New ... ..	128½	189½	50	39½	407½	136	22	8½	90	332½	61½	83½	1½	56	205½	329	295	136	185½	915½
Remodelling	138½	48	85	71½	343	71	132½	105	49	360½	62½	93	63	17	235½	275	273½	253	110½	912
	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.	£ E.
Expenditure	80,944	111,005	58,139	15,773	265,951	96,658	69,661	70,659	69,436	306,411	107,932	98,198	65,151	52,234	323,718	285,531	278,951	193,952	167,113	925,863

SOURCES FROM WHICH FUNDS FOR THIS EXPENDITURE WERE OBTAINED.

YEAR.	From Caisse de la Dette.	From Public Works Budget	From other sources.	Totals
	£ E.	£ E.	£ E.	£ E.
1897 ... ..	248,019	34,002	3,513	285,534
1898 ... ..	252,700	26,254	—	278,954
1899 ... ..	144,773	49,179	—	193,952
1900 ... ..	156,173	11,270	—	167,443
Total ... ..	801,665	120,705	3,513	925,883

The cubes of earthwork executed in Drainage Works other than maintenance are given below:—

	Dredging.	By hand-work.	Totals.	COST.
	C.M.	C.M.	C.M.	£E.
1st Circle ... ..	506,584	957,144	1,463,728	32,623
2nd Circle ... ..	87,183	1,476,656	1,563,839	30,724
3rd Circle ... ..	116,064	1,290,054	1,406,118	30,995
Totals...	709,831	3,723,854	4,433,685	94,342

Information concerning the work done in the different drainage systems is collected in Appendices B to G

### IRRIGATION IMPROVEMENTS.

In the 1st Circle the Saidiyah canal was given a new head with three openings of 2·50 metres width. The old head was too small to pass the discharge which is now required to meet the extension of cultivation that has and is expected to take place along this canal. It is now to be utilised to pass the drainage of the lands to the south under the railway. The new head also carries the railway, necessitating a costly diversion during construction. The cost of this work was £E.1,788.

It has been at last decided that it is better to build a new Head Work to the Ismailiyah canal than to expend more money on costly and hitherto unsuccessful attempts to restore the existing head. The new head will be built close to the river, whereby it is hoped that the heavy silting which takes place yearly between the present head and the river will be economised. It has also been decided to add to the regulators at Siriakus and Bilbeis so as to provide sufficient waterway, which at present they have not got. As a preparation for carrying out these works, a commencement was made with the collection of materials, on which a sum £E.2,160 was expended in 1900.

In the 2nd Circle no works were carried out under this head.

In the 3rd Circle there was an expenditure of £E.32,771 on the following works.

The widening of the Sahel Markaz canal (the object of which was described in last year's Report, page 180) was commenced. In 1899 a sum of £E.1,055 had been expended in expropriating land as a preliminary to the widening. There had also been expended in 1898



a sum of £E.287 in dredging a cube of 7.652 cubic metres from the tail reach of the canal in anticipation of the widening being undertaken, as the clearance of the channel was an immediate necessity. In 1900 the widening was seriously taken in hand and a sum of £E.7,254 expended during the year in widening about 5 kilometres of the tail portion of the canal and, at the same time, remodelling the bridges and renewing the irrigation outlets along the length widened.

Gizah Province, which for some years has had little spent on it while other Provinces were obtaining large grants for drainage works, has, in its turn, benefitted from special grants being made for improvements which do not come under the head of drainage. During the low flood of 1899, much attention was paid to the Gizah Province, and means of improving its system of irrigation were thought out, so that, when money was made available, the Inspector was ready with his proposals.

In 1900, East Gizah was given a new feeder head at Gamazah and Tourah, besides a few small works of distribution.

The principal work in West Gizah was the development of the Gizah Canal along the east side of the railway. This canal, which was dug as a "Sharaki" work after 1888, was apparently left incomplete for want of funds. It has now been enlarged and prolonged, passing under the Abu Nimros Escape and Zummur Canal by iron pipe syphons. The old Abu-Agooz Escape, being so situated as to be utterly worthless as an Escape, has been made to serve as a Head to the Gizah Canal. Two important regulators at Bedreshen and a third at Zummur Canal were constructed, as well as seven smaller regulators, four large road bridges and seventy pipe outlets. Besides these new works, two old regulators were remodelled and given horizontal closure. A new channel was also dug to connect the Agooz Head with the Gizah Canal at Kafr Amr. It is the intention to prolong the channels, with which the Gizah Canal now connects to the Barrage, and there to establish a communication with the Um Dinar Hoshah by means of a pipe syphon to be laid under the Rayyah Beherah.

The construction of these works has immensely improved the irrigation conditions of Gizah for all years, and especially for a year of bad flood. During early flood the river water will in future enter the Province, not only by the Gizah Canal Head, but also by the converted Agooz Head and the Abu Nimros Escape. Water will at first be stored in the Sakkara basin, and the Shabramant basin be kept low so as to maintain a draw-in through the Abu Nimros Escape. The regulators at Bedreshen will allow of the water, entering or stored in

Sakkara basin, being retained or passed on at will. The remodelled Gizah Canal will give an early supply at high levels to the lands bordering the river as far north as the Barrage.

The expenditure on the foregoing Gizah Irrigation Improvements amounted to £E.25,517 during 1900. The works are given in detail in Appendix H.

There was also expenditure incurred under the head of Irrigation Improvements by the Barrage Direction. A sum of £E.5,029 was expended in the collection of materials for the additions and alterations to be made to the Head Work of the Rayyah Beherah Canal. This is the last work of the Barrage group which remains to be remodelled. The proposed work consists of an addition to the existing structure of two more openings and a lock, and of the conversion of the existing lock into two bays by the construction of a central pier. The whole work is to be fitted with iron gates and winch after the pattern of the rest of the Barrage Works.

## CHAPTER V.

### THE BARRAGE AND THE WEIRS.

The expenditure on the Barrage maintenance, exclusive of establishment charges, was £E.13,995. This figure, however, includes a sum of £E.474 for temporary staff charged to works. Adding this latter figure to the establishment charges and deducting it from works, the figures become:— •

	£E.
Staff and office charges ... ..	4,607
Works ... ..	13,521
Total... ..	<u>18,129</u>
The "Works" expenditure is made up as follows:—	
	£E.
<i>River Training</i> ... ..	2,932
<i>Barrage maintenance proper.</i>	£E.
Daily labour ... ..	1,998
Workshop stores ... ..	1,840
Painting ironwork ... ..	348
Floating plant... ..	436
Dredging locks & channels ... ..	650
Masonry repairs ... ..	1,160
Labour under Mr. Mason ... ..	305
	<u>6,737</u>
<i>Carried forward ...</i>	<u>9,669</u>

									<i>Brought forward ...</i> £E.9,669
<i>Special repairs and improvements.</i>									
New workshop engine ... ..									680
Building masonry revetment ... ..									1,101
Stock ramming (settlement of arrears of payment)...									304
									<hr/> 2,085
<i>Gardens.</i>									
New pumping station ... ..									322
Special alterations to grounds ... ..									500
Usual maintenance ... ..									800
									<hr/> 1,622
<i>New model room.</i>									
Collection of materials ... ..									145
									<hr/>
Total... ..									<u>13,521</u>

The sum of £E.2,932. shown as expenditure on River Training, includes a payment of £E.242 made on account of material collected for work in 1901. The training work consists of stone spurs and revetments to protect the new nose of the Delta, where the river bifurcates: of additions to the stone and tree bars formed to encourage the silting up of the Koratayn channel, and of repairs to old spurs. The river channels are gradually taking the form and direction which it is the object of the training works to persuade them to take.

“Rebuilding masonry revetment,” among special repair works, consisted of the reconstruction of that part of the main revetment face, between the Rosetta Barrage and the the Rayyah Menufiyah, which was undermined and destroyed many years ago. This item also includes the reconstruction of the revetment across the head of the channel along the fort ditch which had been used to supplement the supply of the Rayyah Menufiyah. In this portion of the revetment, a culvert was constructed to admit water to the old channel which it is proposed to convert into an ornamental piece of water in connection with the gardens.

Included under the head of masonry repairs is the expenditure incurred in substituting a road surface of compressed asphalt brick for the wood pavement on the Rayyah Menufiyah and Rayyah Tewfiki Heads. The wood pavement has proved unsatisfactory. Its expansion after winter rain causes it to rise in ridges and mounds, displacing the trolley line and forcing the parapet walls outwards.

The parapet walls of both Barrages and of the Rayyah Tewfiki were thus broken off from the body of the masonry some years ago, and had, for the greater part of their lengths, to be dismantled and rebuilt. A considerable space (about 10 inches) was then left

between pavement and parapet to allow for expansion, but this did not prevent the bulging on the roadway. So an experiment was made with asphalt bricks on the two Canal Heads named, and, as it has proved satisfactory, it has been decided to substitute asphalt bricks for wood bricks in the roadway of both Barrages, the total cost of doing which is estimated at about £E.5,000. The asphalt brick roadway costs about 75 piastres a square metre, which is much the same as the cost of the wood brick pavement. The roadway, once laid in asphalt bricks, should not require any repairs for many years. The same hope was entertained of the wood brick pavement, but it has not been realised.

An extra sum of £E.500, beyond the usual allowance of £E.800 for Gardens, was given to allow of the extensive alterations made to the grounds between the Rosetta Branch and the Rayyah Menufiyah. Another sum of £E.322 was expended in setting up a new pumping station on the Rosetta Branch to provide for the watering of the Barrage grounds on the west of the Rayyah Menufiyah, as it was found that it could not be efficiently done from the workshop on the other side of the canal. Besides these sums, a further sum of £E.887 was expended from the Garden Fund.

It has been decided to build a Model Room at the Barrage to hold any irrigation models that may be made from time to time. It is hoped that an interesting and valuable collection will be made, which will serve as a useful record of works constructed and as a means of instruction to engineers being educated in the country. The small sum of £E.145, expended on this account, was for the partial collection of materials required.

#### WEIRS BELOW THE BARRAGE.

It was pointed out in last year's Report, that, before the end of 1899, preparations had been made for the 1900 season, the programme for which was a heavy one. The programme proposed was the complete construction of the Rosetta Branch Weir to one metre below finished crest level, and of as much of the lock as was possible. The lock on the Damietta Branch was also to be completed, and the Weir of that Branch still further raised. Also additions were to be made to the Barrage gates.

On 1st November, 1899, dredging had been begun, and by the end of the year two blocks at the east end of the core wall had been formed, and one block of the lock walls at the west end. Work had

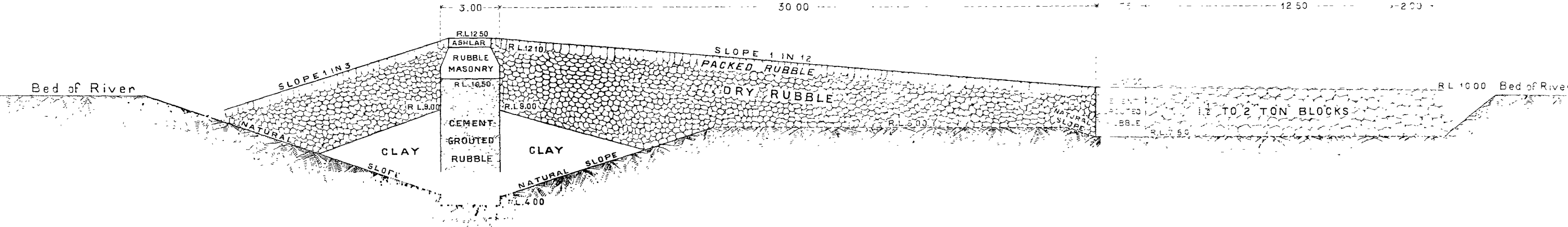
also been resumed on the Damietta Branch lock and good progress made.

Work on the footing wall also of the Rosetta Branch Weir was commenced on 24th January, 1900. At this time five rafts were at work on the lock and core walls, and were getting in the deep blocks ( $6\frac{1}{4}$  metres high  $\times$  3 metres broad) at the rate of about 85 lineal metres a week, giving a cube of grouted masonry of 1,600 cubic metres. The footing and cross walls were constructed at rates varying from 60 to 109 lineal metres a week, or from 500 to 750 cubic metres. By 7th April all the grouted work below water was finished, the lock floor grouting having been previously completed on 3rd March. So far the work had gone well, though the block-forming was at times retarded by failure to supply the different rafts with material as quickly as it could be used up. But, at this stage of the works, as in the former season, the transport and placing of clay and rubble pitching progressed very badly. There were over 100,000 cubic metres of these materials to put in place and eleven weeks in which to do it, allowing one month afterwards for building the surface slope. From 21st April to 5th May only 6,500 cubic metres were put in place in a fortnight. As this rate was evidently due to bad arrangements, the traffic management had to be re-organised with the result that, during the next five weeks, 66,500 cubic metres were put in place in the weir; that is, at a rate four times greater than before. By the 30th June all the heavy talus blocks downstream of the footing wall were in place, and, by the middle of July, the weir was sufficiently complete to be ready for the flood. Work, however, still continued until 29th July. On 30th July the gates of the Rosetta Barrage were partly opened and the work was put under water. The year's programme had been more than fully accomplished. The Rosetta Branch Weir, 500 metres long, had been carried across the river and completed for 300 metres of its length to 90 centimetres below crest level, and for 100 metres to 40 centimetres below the same level, while 100 metres of it was completely finished, together with the dry rubble revetments on the east bank. The lock also with its revetments had been completely finished, even to the hanging of the gates and fixing the opening gear. The weir on the Damietta Branch was also added to: about 180 metres length was completely finished and another 60 metres raised 90 centimetres; its lock was completed and gates hung.

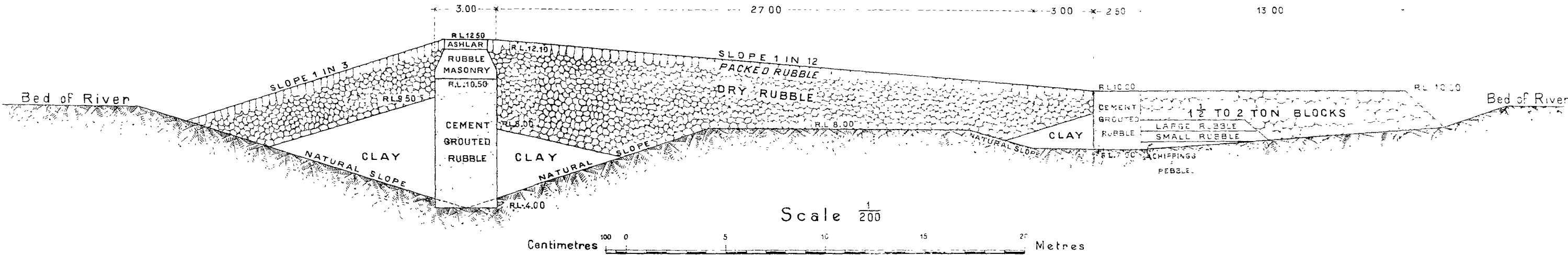
Besides the work on the two weirs, the Barrage itself had additions of one and a half metres height fixed to its 122 upper gates, and a third winch for lifting the gates was added to each Barrage. The top

# CROSS SECTIONS OF WEIRS

DAMIETTA WEIR, 418 Metres Long



ROSETTA WEIR, 500 Metres Long





of the gates, when down, is now at R.L. 15.56 instead of at R.L. 14.00 as before.

The manner of building the weirs and their locks was fully described in last year's Report. More plant than was available in 1899 was got ready for the 1900 season, so as to make more certain of carrying through the programme. The foundations of the Rosetta Branch lock were got in by grouting, as in the case of the Danielta Branch lock, but the operation was not continuous from beginning to finish, as heavy rain interfered with the work. The grouting commenced on 24th February: at noon of 25th February heavy rain stopped the work, as also the transport of cement by camels. On 26th February grouting was recommenced, but was stopped again at night by rain. On 27th February grouting was again resumed and again broken off for want of cement, as the rain had made the ground so slippery that camels could not move. On 28th February, the cement transport became again possible. In consequence of these delays the grouting of the lock floor was not complete till 4 p.m. of 3rd March, on the eighth day from the commencement. Nevertheless, when the enclosed space was pumped out on 4th March, the grouted layer was perfectly sound and there was not the sign of a leak or spring anywhere.

The rest of the lock was then built in the dry in the usual way. As soon as the sluice passages in the lock chamber walls were complete, the discharge of water, passing between the two advancing ends of the core wall, was diverted through the lock, and the core wall could then be closed right across. Channels were left in the core wall down to the level of the downstream water level in order to avoid getting a head of water on the wall before the clay and rubble were in place on both sides of it. Channels were also left in the footing and cross walls till the last, to prevent a head coming on any of the walls till all was complete.

The core wall and side walls of the lock foundations were constructed by means of five of the rafts described in last year's Report, p. 173. A sixth had been got ready, but was not employed for several reasons, namely, because the extra staff employed was inexperienced, and the whole staff was only equal to the superintendence of five; because also there was barely room for a sixth raft; and, lastly, because the transport of materials was not well enough organised to fully supply even five. On the footing and cross walls two of the apparatus, designed by Mr. Mason and figuring in last year's Report, were employed, and help was also given by the core wall rafts when their work on the core and lock was done. Altogether, including the lock floor, a masonry



cube of 23,140 cubic metres was grouted with an expenditure of 84,904 barrels of cement; which gives a rate of 3.67 barrels per cubic metre, or 40%, the proportion assumed when making the original estimates of the work. If there had been no leaky boxes, the rate would have been about  $3\frac{1}{2}$  barrels to the cubic metre, or  $37\frac{1}{2}\%$ , which appears to be the usual proportion for a sound box.

It sometimes happened that a crack appeared between the blocks of grouted rubble, probably due to settlement of the outer end of the last formed block before the next block in advance could be formed. In the Damietta Branch Weir a bore was jumped in the centre of the width of the core wall along the line of the crack down to below the level of the clay filling, and, after all the clay and rubble was in position on both sides of the core, cement grout was poured down the bore to fill up the crack. When building the Rosetta Branch Weir, in order to save the labour of boring, it was contrived that vertical holes should be left on the junction line between two blocks, and these holes were afterwards grouted up as a last operation after the clay and rubble on both sides were in place, whether cracks appeared or not. The vertical hole was formed by first fixing a semi-circular pole in the centre of the outer end of the box being formed and outside the box lining of sacking. After the block was completed, in the semi-cylindrical groove thus formed there was fitted a tapered rod, entirely covered by rope wound spirally and tightly round it, and the next block, when made, enveloped the rod and rope. As soon as the block had set, the tapered rod was first extracted, leaving the rope behind; and the rope was afterwards pulled out with ease, leaving a clean hole from top to bottom at the junction of two blocks.

Another system was also tried with fair success. The semi-cylindrical hole was formed as before described. When the next box was being formed, a plank was laid flat against the end of the last formed block covering the semi-circular groove, which was then filled with sand at the same time that the box was filled with rubble. When this second block was being grouted, the sand filling kept out the cement; and, when the time came for grouting the junction, the sand was easily removed, leaving the vertical hole to receive the grout.

The cross sections, to which the weirs were actually built, are given in the accompanying plate. The addition of clay and filter bed materials were added to the Rosetta Branch Weir on account of observations made during the construction of the Damietta Branch Weir. On 21st July, 1899, when the Damietta Barrage gates were closed to facilitate the diversion of the water passing the Weir, and the water level down-

stream of the Weir was consequently lowered to a level below that of the top of the footing wall. strong springs were observed just below the footing wall. It was found that the springs were due to the water ponded up between the core, footing and cross walls finding its way under the footing wall. The water level in three of the compartments lowered itself to that of the river downstream of the footing wall: the other two compartments held water.

It was undesirable that the flow of water under the footing wall should take place for fear of undermining the wall and causing settlement of the rubble pitching between the walls by the removal of the river bed material below them. This could be prevented, either by cutting channels in the footing wall down to or below lowest water level and so preventing any head coming on the footing wall: or by making the footing wall hold water against a head of 50 to 65 centimetres as a maximum. The latter was chosen as the more desirable alternative, and the cross section for the Rosetta Weir was modified accordingly. The footing wall was carried half a metre deeper and clay added upstream. As a precaution against possible leaks occurring in spite of the clay addition, a filter bed also was added downstream to prevent such leaks carrying with them any of the substratum. By this arrangement it is provided that the footing wall holds up to R.L.10 (which means that it may have to support an extreme head of 65 centimetres), and that the core wall holds up 2.50 metres as a maximum to obtain R.L.12.50 in the pond upstream of it.

The footing wall of the Damietta Branch Weir had, after the passage over it of the first flood, become watertight. The minimum level on this branch does not fall quite so low as on the Rosetta Branch, and it is probable that the bed downstream of the Weir will become, in the future, more uniform between the two banks of the river, and that the bed of the river itself will be little, if at all, below R.L.10.00 at any point. Consequently it would have mattered little, if the footing wall on this weir had not become watertight.

The remarks that were made about the staff in last year's Report (pages 170 and 171) apply to the next season's work without modification. The work done in 1900, and the duties performed by each member of the staff and the manner of performing them, were almost identical repetitions of the year before, except only that there was more work to do and more experience to help in doing it.

The quantities of work done during the three past seasons are given in the following Tables:—

DAMIETTA BRANCH WEIR AND LOCK.

	1898	1899	1900	TOTAL.
Dredging ... ..	38,010	173,808	2,000	213,818
Earthwork ... ..	51,139	20,031	55,000	126,170
Grouted masonry... ..	2,939	17,491	—	20,430
Skipped concrete... ..	400	1,260	—	1,660
Rubble masonry in homra and lime... ..	641	4,144	774	5,559
Do. in sand and cement ... ..	—	2,476	—	2,476
Brick masonry (lock)... ..	—	1,300	3,728	5,028
Ashlar masonry ... ..	54	351	634	1,039
Dry rubble masonry ... ..	6,892	56,773	15,097	78,762
Heavy talus blocks ... ..	800	12,130	—	12,930
Clay on sides of walls... ..	4,000	15,785	1,566	21,351

ROSETTA BRANCH WEIR AND LOCK.

Dredging ... ..	184,984
Earthwork ... ..	108,816
Grouted masonry ... ..	23,140
Rubble masonry in homra and lime ... ..	3,531
Do. in sand and cement ... ..	3,842
Brick masonry ... ..	5,011
Ashlar masonry ... ..	990
Dry rubble masonry ... ..	87,462
Heavy talus blocks ... ..	14,275
Clay on sides of walls ... ..	33,730

During the 1900 season 94,789 barrels of cement were used in the work, of which 84,904 barrels were expended in grouting.

The expenditure on the weirs for the three seasons is as follows:—

	£E.
1898 ... ..	81,856
1899 ... ..	159,873
1900 ... ..	182,263
Total... ..	<u>£E.423,992</u>

The expenditure for 1900 includes a sum £E.13,157 paid for the additions to the Barrage gates, and for two winches, one for either Barrage.

There remains little to be done in 1901 to complete the weirs. About five or six weeks' work on each will finish them.

## CHAPTER VI.

### WORKS.

As in previous Reports, the expenditure, as it appears in the accounts, is given in Appendix A. The accompanying statement, however, groups the expenditure more in accordance with the actual expenditure, and separates Establishment Charges from Works more correctly; all staff, other than daily labour, and all office charges, including Dahabiehs, being included under Establishment. The staff on pumping stations only is included with the expenditure shown under that head.

#### EXPENDITURE, 1900.

	1st Circle	2nd Circle	3rd Circle	Barrage	TOTAL
ESTABLISHMENT CHARGES	£E.	£E.	£E.	£E.	£E.
Budget ... ..	18,526	17,781	15,474	4,607	56,388
Caisse { Drainage ... ..	2,129	2,308	4,164	—	8,601
{ Weirs ... ..	—	—	—	1,239	1,239
Totals... ..	20,655	20,089	19,638	5,846	66,228
WORKS.					
New Works ... ..	938	1,019	392	145	2,494
Protective Works ... ..	5,817	10,263	7,216	2,932	26,228
Maintenance—Masonry ...	3,125	2,355	2,194	8,822	16,496
" Earthwork ... ..	54,490	51,729	38,204	—	144,423
" Dredging... ..	22,856	14,146	9,255	—	46,257
" Roads ..... ..	1,328	937	257	—	2,522
" Gardens ... ..	—	—	—	2,509	2,509
New Roads... ..	6,421	25,037	353	—	31,811
Ferry fund Bridges... ..	2,080	1,875	1,029	—	4,984
Special Low Nile expenditure—Caisse... ..	5,599	3,322	20,944	—	29,865
Pumping Stations ... ..	See Chapter III.	—	10,319	—	10,319
New Drainage { Budget, N.	1,744	6,586	2,940	—	11,270
Works { Caisse, ... ..	41,900	60,542	44,694	—	147,136
Irrigation Im- { Budget, N.	3,948	—	20,279	5,029	29,256
provements, { Caisse, ... ..	—	—	12,492	—	12,492
Weirs—Caisse ... ..	—	—	—	181,024	181,024
Wadi Tumilat Reclamation	18,971	See Chapter VII.	—	—	18,971
Land Charges ... ..	—	532	402	—	934
Registration of lifting machines ... ..	—	138	—	—	138
Total Works... ..	169,217	178,481	170,970	200,461	719,129
Total Establishment and Works. . . . .	189,872	198,570	190,608	206,307	785,357

#### NEW MASONRY WORKS.

The most important New Work of the year was the construction of the subsidiary weirs below the Barrage. This work, as well as work charged against the ordinary Barrage Budget, was described in the last chapter.

The New Works charged to the ordinary Budget are few and unimportant. They are detailed below by Circles:—

		£E.
<i>1st Circle.</i>		
Head Sluice.—Shebul Canal	Tail branches of Bahr Saghir	401
„ A-safra „	„	140
„ Bahr Abu el Akhdar on Bahr Saghir	...	208
„ Tamay Canal	... ..	163
Five pipe-sluiques	... ..	26
Models	... ..	938
<i>2nd Circle.</i>		
Regulator on Ganabieh Shabshir	... ..	228
Completion of Dalgamun Bridge	... ..	67
Wooden bridges, culvert, pipes and small works	... ..	724
<i>3rd Circle.</i>		
Head Sluice.—Min-had Bulin	... ..	352
Models	... ..	40
<i>Barrage.</i>		
Collection of materials for Model Room	... ..	145
Total		£E.2,494

The *important* masonry works executed were charged to special grants and have been referred to under the heads of Drainage Works and Irrigation Improvements in Chapter IV.

#### RIVER AND CANAL PROTECTIVE WORKS.

There is again a slight decrease of expenditure under this head, the total sum expended in 1900 being £E.26,228 as against £E.27,542 in 1899. The details are given below:—

		£E.
<i>1st Circle.</i>		
River spur and revetments, Kaliubiyah	... ..	1,200
„ „ „ „ Dakahliyah	... ..	4,008
Store, Benha	... ..	438
Land for Nile bank retirement	... ..	171
<i>2nd Circle.</i>		
River.—Spurs and revetments	... ..	5,536
„ Purchase of flood materials	... ..	1,173
„ Store	... ..	132
Canal.—Spurs R. Menufiyah	... ..	3,073
„ Planting R. Menufiyah slopes	... ..	349
<i>3rd Circle.</i>		
River.—Spurs and revetments, Beherah	... ..	1,481
„ „ „ „ Gizeh	... ..	3,251
„ Purchase of flood materials	... ..	1,030
„ Nile bank diversions	... ..	403
Canal.—Rayyah Beherah planting	... ..	660
Sea-Wall.—Abukir	... ..	391
<i>Barrage.</i>		
River training and protection	... ..	2,932
Total		£E.26,228

The decrease of expenditure would have been greater had it not been for the increase of expenditure on the Menufiyah spurs, which are being made with the object of decreasing silt deposit and of so effecting a future economy in dredging.

### MAINTENANCE MASONRY.

The work done under this head at the Barrage has already been dealt with in the preceding Chapter. In the Circles a large number of works were repaired, but there was no single repair work of sufficient importance to be separately mentioned. The total expenditure under this head, including the Barrage expenditure, was £E.16,496.

### EARTHWORK BY HAND.

The quantities and cost of earthwork executed by hand during the year 1900 are given below:—

EARTHWORK BY HAND	1st Circle.	2nd Circle.	3rd Circle.	TOTALS.
	C.M.	C.M.	C.M.	C.M.
Maintenance canals, drains and banks ... ..	3,969,537	2,706,567	2,287,604	8,963,708
Irrigation Improvements ... ..	—	—	611,330	611,330
New Drainage Works ... ..	957,144	1,476,656	1,290,054	3,725,854
Totals ... ..	4,926,681	4,183,223	4,188,988	13,298,892
Cost ... £E.	69,872	79,588	78,702	—
Rate ... P.T.	1.42	1.90	1.88	—

The foregoing figures include all the earthwork done excepting the earthwork executed in the construction and maintenance of agricultural roads, and also the earthwork forming part of the construction of masonry works, such as, for example, the earthwork charged against the Weirs' estimate.

### DREDGING BY MACHINERY.

The quantities dredged in canals and drains for the past five years are given in the statement which follows. In the table the dredging done as maintenance of existing channels is separated from dredging executed in remodelling works.

The following table gives the quantities dredged in canals and drains for the past five years:—

CANALS AND DRAINS.	1895-1896	1896-1897	1897-1898	1898-1899	1899-1900
1st CIRCLE.	C. M.	C. M.	C. M.	C. M.	C. M.
<i>Maintenance.</i>					
Ismailiyah ... ..	139,845	206,976	224,316	*322,471	225,096
Sharkawiyah ... ..	76,283	113,983	111,916	125,557	77,462
Basusiyah ... ..	124,182	132,263	183,485	152,854	195,969
Kumbatin ... ..	65,748	62,293	64,848	51,412	62,504
Wadi ... ..	—	96,888	—	—	—
Bahr Saghir ... ..	61,127	14,286	50,027	2,823	70,197
Bahr Mues ... ..	8,957	—	—	—	—
Mansurah lock ... ..	2,422	32,779	15,905	22,648	15,000
Total Maintenance ...	478,564	659,468	650,528	677,765	646,228
<i>Remodelling.</i>					
Sanaytah lock ... ..	—	—	—	5,353	—
Sirn drain ... ..	12,507	—	50,413	—	—
Bahr el Bagar drain ...	127,352	146,830	227,387	215,853	133,640
Bahr Tawil drain ... ..	—	—	—	116,706	72,944
Total Remodelling ...	139,859	146,830	277,800	367,912	506,584
Grand Totals ... ..	618,423	806,298	928,328	1,045,677	1,152,812
Expenditure ... .. £E	26,426	29,382	33,490	37,352	40,095
2ND CIRCLE.					
<i>Maintenance.</i>					
Menufiyah ... ..	193,783	198,591	265,069	399,937	255,535
Kasid ... ..	—	—	112,676	—	138,204
Bahr Tirah ... ..	—	—	—	74,810	5,959
Kodabah lock ... ..	7,629	11,577	6,979	10,530	5,512
Baguriyah ... ..	—	—	—	—	4,424
Total Maintenance ...	201,412	210,168	384,728	485,277	409,634
<i>Remodelling.</i>					
Muhit drain (No. 1) ...	—	242,721	218,298	84,000	—
Demillash drain ... ..	—	—	—	114,000	87,183
Sharkawiyah drain (No. 4) ...	45,688	—	—	—	—
Total Remodelling ...	45,688	242,721	218,298	198,000	87,183
Grand Totals ... ..	247,100	452,889	603,022	683,277	496,817
Expenditure ... .. £E.	8,898	16,078	21,395	23,279	17,110
3RD CIRCLE.					
<i>Maintenance.</i>					
Ray, Beherah & Katatbeh canal	162,031	139,275	230,916	185,982	136,516
Mahmudiyah canal ... ..	100,285	118,464	120,996	123,434	117,530
Mex Pumps inlet channels ...	12,172	6,939	11,006	—	—
Nubariyah canal ... ..	—	59,615	—	37,980	17,843
Total Maintenance ...	274,488	324,293	362,918	347,396	271,889
<i>Remodelling.</i>					
Sahel Markaz canal ... ..	—	—	7,652	54,398	—
Din-shu drain ... ..	—	8,558	—	5,863	—
Shershrah drain ... ..	—	7,600	—	—	—
Edku drain ... ..	—	—	142,289	256,967	16,834
Unum drain ... ..	—	—	18,500	—	99,230
Mahmudiyah Special ... ..	—	—	—	—	82,633
Total Remodelling ...	—	16,158	168,450	317,228	198,697
Grand Totals ... ..	274,488	340,451	531,368	664,624	470,586
Expenditure ... .. £E	11,156	12,044	19,561	21,876	17,033

\*The Ismailiyah cube for 1898-1899 includes 60,000 cubic metres executed the year before in the Suez branch, but not paid for.

The dredging belonging to “New Drainage Works” is also included in the list of drainage works given in Appendices B, D and F.

The totals abstracted from these tables are :—

DREDGING ON ALL ACCOUNTS.	1st Circle.	2nd Circle.	3rd Circle.	Totals.
Maintenance canals and drains...	646,228	409,634	271,889	1,327,751
Irrigation Improvements ... ..	—	—	82,633	82,633
New Drainage Works ... ..	506,584	87,183	116,064	709,831
Totals.... ..	1,152,812	496,817	470,586	2,120,215

The only dredging not included in the foregoing is that done as part of the work of construction of the new weirs described in Chapter IV, and dredging locks and lock channels executed under the Barrage Direction.

#### HANDWORK AND DREDGING.

Abstracting all the foregoing, we get the following figures for 1900 :—

##### HANDWORK.

	Cubic metres.
Maintenance of banks, canals and drains ... ..	8,963,708
Irrigation Improvements ... ..	611,330
New Drainage Works ... ..	3,723,854
Total... ..	<u>13,298,892</u>

##### DREDGING.

Maintenance of canals and drains ... ..	1,327,751
Irrigation Improvements ... ..	82,633
New Drainage Works ... ..	709,831
Total... ..	<u>2,120,215</u>
Grand total cubic metres... ..	<u><u>15,419,107</u></u>



## AGRICULTURAL ROADS.

### *Construction of new Roads.*

The following statement shows the progress made with Agricultural Roads and the expenditure during 1900 :—

CIRCLE AND PROVINCE.	Existing at end of 1899.	Added during 1900.	Total at end of 1900.	Expenditure 1900.
	Kilom.	Kilom.	Kilom.	£ E.
<i>1st Circle.</i>				
Kaluibiyah ... ..	107	—	107	} 6,421
Sharkiyah ... ..	177	25½	202½	
Dakahliyah ... ..	169½	34	203½	
<i>2nd Circle.</i>				
Menufiyah ... ..	252	27	279	} 25,037
Gharbiyah ... ..	531½	160½	692	
<i>3rd Circle.</i>				
Beherah... ..	281½	—	—	129
Totals... ..	1,518½	247	1,765½	31,887

The small sum expended on Beherah roads was in settlement of land purchases of previous years: of this £E.243 was charged to Regular Budget, as the road collections were exhausted.

### *Maintenance of Roads.*

The sums spent on road maintenance were as follows :—

	£E.
1st Circle ... ..	1,328
2nd „ ... ..	937
3rd „ ... ..	257
Total ... ..	<u>2,522</u>

£E.243 of the Budget allotment for road repairs in 3rd Circle was taken to pay for land acquired for roads, as the Mudir failed to collect the amount required to cover the first cost of the roads. Except in the 1st Circle the expenditure on road maintenance was wholly insufficient to keep the roads in proper repair, the funds available for this work being inadequate.

Mr. Verschoyle in his Report makes the following remarks about the repairs of Agricultural Roads in the 2nd Circle:—

As noted in the Report for 1899, the total length of Agricultural Roads existing in the Circle at the end of the year, including 311 kilometres of roads made over by the Domains, was 783·5 kilometres. The expenditure on maintaining this length during the year was £E.936.818 or £E.1.195 per kilometre. I stated in last year's Report that an expenditure £E.3·7 per kilometre was required to keep the roads in fairly good order: so, needless to say, the steady ruin of these roads continues. The sum available was spent in maintaining labor gangs each under a Rais, and all under the control of Mr. Moore. This is undoubtedly the best system so long as there is an active officer like Mr. Moore to look after the said gangs and see that they give a fair return in labour for the expenditure incurred. Mr. Moore's presence is, however, due to the fact of the large kilometrage of roads under construction. With the insignificant sum at present allotted for road maintenance, it would be impossible to maintain a special officer to supervise it. During the year the kilometrage to maintain has been increased by 187·5, but the budget figure for road maintenance during 1901 stands at the same figure of £E.800 as before. It is perfectly clear that funds will have to be found for the maintenance of these roads. I believe that there would be little difficulty in collecting a tax for the maintenance at least of the roads not monopolised by Light Railways. Opposition to a tax for the latter class of roads would be natural.

These remarks are a repetition of what has appeared in previous reports. The situation is correctly stated. The existing roads are going from bad to worse: no new roads' project can be considered until the maintenance question is settled. The Inspectors of Irrigation have received orders to ascertain the views of the Mudirich Councils as regards a roads' cess for the maintenance of these roads not exceeding one piastre a feddan.

#### BRIDGES TO REPLACE FERRIES.

Under this head there was an expenditure during the year of £E.4,984, distributed as follow:—

	£E.
1st Circle ... ..	2,080
2nd „ ... ..	1,875
3rd „ ... ..	1,029

The bridges on which this expenditure was incurred were the following:—

1st Circle.	£E.
Government share of Light Railway bridges over Bahr Moës at Zagazig ... ..	1500
Government share of Light Railway bridges over Bahr Fakûs on the Abu-Kebir—Abu-Hamad road ... ..	580
	<u>2080</u>

<i>2nd Circle.</i>	£E.
Melig Bridge over Kasid Canal ... ..	119
Shibin el Kom bridge over Bahr Shibin ... ..	215
Afnish bridge over Bahr Tirah ... ..	1,375
Melig bridge over Bahr Shibin ... ..	11
Bagur bridge over Baguriyah Canal ... ..	<u>155</u>
	<u>1875</u>

In the 3rd Circle the bridge at Teriyah over the Rayah Beherah, and that at Rahmaniya over the Sahel Markaz Canal were completed and finally paid for, the expenditure on this account being £E.1,029, making a total with the preceding year's expenditure of £E.2,829 for the two bridges.

#### SPECIAL LOW NILE EXPENDITURE.

On account of the exceptionally low levels of the Nile between the floods of 1899 and 1900, the Commissioners of the Caisse de la Dette gave special grants for expenditure to be incurred to meet the necessities of the abnormal situation, the detail of which expenditure, amounting altogether to £E29,865, is as follows.

In the 1st Circle a sum of £E.663 was spent in paying the salaries of special staff appointed to control the summer distribution by means of the rotation programmes. There was also expended on the temporary dam across the river below Damietta a sum of £E.4,936.

In the 2nd Circle, £E.1,033 was spent on special staff, and a further sum of £E.409 on the purchase of materials and on the expenses of a steam launch maintained for inspection purposes. On the temporary pumping station at Kebrit on the Rosetta Branch, £E.1,420 was expended. The foregoing items belong to the summer expenditure. As there was a balance unspent available, a further sum of £E.460 was expended in providing irrigation for 5,515 feddans of high Sahel, which the flood of 1900 was too low to reach. The sum of all this expenditure in 2nd Circle is £E.3,322.

In the 3rd Circle, £E.20,944 was expended against these special grants on the following objects:—

	£E.
Mehaller El-Emir Sadd ... ..	9,408
Working Atfeh pump ... ..	4,955
Rotation staff ... ..	1,000
Special dredging Mahmudieh ... ..	3,882
Flood measures for irrigation of high Sahel ... ..	<u>1,699</u>
	<u>20,944</u>

All these objects of expenditure have been dealt with in Chapters I and II, excepting only the "Special Dredging Mahmudieh." This dredging was undertaken to improve the conditions of the canal Mahmudieh in the neighbourhood of the Alexandria Waterwork's intake.

## CHAPTER VII.

### THE WADI TUMILAT.

The arrangement according to which the estate of the Wadi Tumilat is being administered was fully described in last year's Report. The management continues to produce better results than those represented by the figures used in the original forecast. Mr. J. Langley, Inspector of Irrigation, with Musa Bey Galeb under him as Resident Director, is responsible for the management.

The expenditure during 1900 against the Capital account on works of improvement and reclamation amounted to £E.18,971, made up as follows:—

<i>Drainage and reclamation works.</i>										£E.
Enlargement of pumping station	...	...	...	...	...	...	...	...	...	2,435
Enlargement of main drain	...	...	...	...	...	...	...	...	...	9,234
Branch and field drains and field channels	...	...	...	...	...	...	...	...	...	<u>2,067</u>
										13,736
<i>Remodelling irrigation system.</i>										
Earthwork, Sanduk and Gabal Canals	...	...	...	...	...	...	...	...	...	1,986
3 Regulators and 2 Head Sluices	...	...	...	...	...	...	...	...	...	1,116
Pipes and bridges	...	...	...	...	...	...	...	...	...	455
Wartermill	...	...	...	...	...	...	...	...	...	<u>123</u>
										3,680
<i>Purchase of plant.</i>										
Ploughing plant	...	...	...	...	...	...	...	...	...	256
<i>Staff and farm buildings.</i>										
Ezbehs	...	...	...	...	...	...	...	...	...	218
Staff	...	...	...	...	...	...	...	...	...	<u>458</u>
										676
<i>Staff expenses and sundries.</i>										
Salaries	...	...	...	...	...	...	...	...	...	426
Travelling allowance and sundries	...	...	...	...	...	...	...	...	...	<u>197</u>
										623
										<u>£E.18,971</u>

The pumping station was enlarged by the erection of a new 20-inch pump and a compound vertical engine, the masonry alterations to the station being so designed as to provide for the further addition of a third 30-inch pump, if it should hereafter be found necessary. The £E.2,435 expended on this account includes £E.77 for the purchase of a weighing machine. The provision of a 20-inch pump allows of more economical working when the amount to be pumped is not sufficient for a 30-inch, or too much for one but not enough for two 30-inch. A 30-inch pump can be worked with the 20-inch by the steam from a single boiler. The pumping station is now equal to

lifting  $2\frac{1}{2}$  cubic metres a second, the smaller pump lifting  $\frac{1}{2}$  cubic metre and the larger pumps 1 cubic metre apiece.

The enlargement of the main drain has had very marked results in drying up the land. Some of it has been so thoroughly drained as to form surface cracks. Mr. Langley anticipates that he will, in consequence, be able to reduce the number of branch and field drains which he had contemplated making.

The canal remodelling consists mainly in substituting properly aligned canals with efficient means of regulation for improperly aligned channels without means of control. The Sanduk and Gabal canals take up the irrigation formerly effected by high level canals crossing the main drain and valley at right angles. The Gabal canal has its head on the Ismailiyah canal near Abassa and serves the upper half of the estate; the Sanduk has its head at Kassassin and serves the lower half.

A flour water-mill, after the pattern of the Fayum mills, has been set up on one of the new Gabal canal regulators, and it promises to be remunerative.

The total estimated expenditure on the reclamation works is £E.62,189 (see p. 192 of last year's Report). The expenditure on this account has been:—

	£E.
In 1899... ..	7,132
In 1900... ..	18,971
Total... ..	<u>£E.26,103</u>

Revenue.

The revenue account for 1900 shows the following results:—

	Estimated.	Actual.	Increase
	£E.	£E.	£E.
Receipts... ..	19,451	19,957	506
Expenditure... ..	19,451	19,643	192
Surplus... ..	--	344	—

The details of receipts and expenditure are given below.

	RECEIPTS.	£E.
Rent of 9,382 feddans...		18,832
.. palm trees ... ..		228
.. grazing and wild "Samar" ... ..		766
.. gardens and houses ... ..		66
.. incubator ... ..		20
Sundry ... ..		45
Total... ..		<u>£E.19,957</u>

EXPENDITURE.

	£E.
Staff ... ..	1,944
Taxes ... ..	5,867
Payment to Ministry of Public Instruction ... ..	8,000
Working expenses of Kassassin pumping station... ..	3,230
Canal and drain maintenance ... ..	477
Petty expenses ... ..	125
	<u>19,643</u>
Surplus... ..	314
	<u>£E.19,957</u>

The expenditure on pumping exceeded the estimate made at the beginning of the year by £E.779. This was almost entirely due to the rise in the price of coal.

The year 1900 is, properly speaking, the first year of the forecast, but as it is, in some respects, intermediate between the 1st and 2nd years, the figures for both are given below to enable a comparison of actual results to be made with either:—

	Year of new management.	Expenditure	Receipts.	Surplus.	Deficit
Forecast.. ... {	1st	19,350	15,710	—	3,640
Actual results ... {	2nd	19,350	17,200	—	2,150
	1900	19,643	19,957	314	—

The areas leased for the past three years and the estimated area for 1901 are given by the following figures:—

	Actually leased.	Forecast
1898	6,917 feddans	8,000 assumed as actual wrongly.
1899	7,578 „	8,000
1900	9,382 „	9,000
Estimated 1901	11,332 „	10,000

In last year's Report, page 197, the area rented was given wrongly as 6,917 instead of 7,578. On page 195, the leased area added in 1899 is shown as 1,856 feddans. This also is incorrect. There was added only 661 feddans in consequence of measurements of the cultivated areas disclosing the fact that more was cultivated than the total of the leases. The difference between 1,856 and 661, or 1,195, was the new area rented at the end of the year, but for which no rent was due in 1899.

The crops were all good in spite of the very low levels of the Nile. The cotton crop in the Wadi did not suffer so much from the September weather as cotton elsewhere did, though its yield was diminished. To counterbalance what damage the weather may have caused, the

price, at which the cotton sold, was high, the greater part of the cotton fetching P.T.345 the kantar.

The durah crop was exceptionally good. The Samar and rice crops were also good, having been saved during the period of severe rotations by the water raised by the pumps, which was found by analysis to be sufficiently sweet for the irrigation of these crops. Consequently, though the rents collected gave a sum in excess of the collections of 1899 by £E.4,000, the tenants were in better case, and not a single piastre of rent due remained unpaid at the end of the year. I think this shows that the management of the estate is being conducted on correct lines.

It is a point worth recording that the system of surface washings, which not many years ago was condemned in Lower Egypt as a worthless method to adopt for reclaiming land, has now found favour in the eyes of the managers of the Wadi Tumilat, Aboukir and Bessendila estates and with the New Daira Sanieh Company. At the time that surface washings were employed with great profit for the improvement of part of the Salakus lands near Fechu, the system was held to be inefficient elsewhere, and the adoption of it in Middle Egypt was derided and its success denied.

### CONCLUSION.

Important changes took place among the staff at the end of the year in consequence of the lamented death of Mr. Wilson, Director General of Reservoirs. The resulting changes in Lower Egypt were effected before the end of the year in the month of December. Mr. A. L. Webb having been appointed to succeed Mr. Wilson as Director General of Reservoirs, Mr. K. E. Verschoyle was promoted to be Inspector General of Upper Egypt. Mr. Verschoyle has had charge of both the 3rd and 2nd Circles as Inspector, and did excellent work in both. I record here my hearty regret at losing so good an Inspector. Mr. C. E. Dupuis, during the short time that he was Inspector of the 3rd Circle, so well acquitted himself and showed such a grasp of the problem with which he had to deal and such a thoroughness in his manner of dealing with them, that he was selected to succeed Mr. Verschoyle in the important post of Inspector of the 2nd Circle. Mr. G. H. Finlaison, Director of Works, who has always performed his duties as Assistant Inspector satisfactorily and had charge of the 3rd Circle while the Inspector was on leave during last flood season, as well as on previous occasions, was given temporary charge of the Circle on Mr. Dupuis being transferred.

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ANNEX TO THE REPORT OF THE IRRIGATION DEPARTMENT,  
LOWER EGYPT.

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NOTES

ON THE WORKING OF THE AÏFEH PUMPS IN THE SUMMER IN 1900, AND THE INFILTRATION  
WATER OF THE ROSETTA BRANCH AS A SOURCE OF SUPPLY

BY

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## NOTES

### ON THE WORKING ATFEH PUMPS IN THE SUMMER OF 1900, AND THE INFILTRATION WATER OF THE ROSETTA BRANCH AS A SOURCE OF SUPPLY.

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The experience and information gained in connection with the construction of the Mehallet el Amir Sadd, and the working of the Atfeh Pumps during the past summer, are so valuable as to be worth putting on record in a convenient form before the details are lost and the matter forgotten.

The conditions of the season were about as unfavourable as possible for the infiltration supply, as not only had the preceding flood been the lowest on record, but the winter rainfall was light, and the Rosetta Barrage was tightly closed at the earliest possible date to facilitate the works in connection with the subsidiary weir under construction immediately below it. The Barrage may be considered to have been wholly closed and the Rosetta Branch dependent on infiltration water alone from the 10th of February.

Before the end of November, 1899, it was foreseen that the construction of the Mehallet el Amir Sadd was inevitable, but owing to the delays incidental to arranging for funds, making the preliminary survey and estimate, publishing the call for tenders, and making the contract, the work was not actually started till the end of January, 1900.

All appreciable flow in the river had ceased by this time, and its mouth at Rosetta for a distance of 160 kilometres inland was but a narrow deep sea inlet, temporarily filled with a mass of fresh water, and oscillating gently with the daily tides, which have a range of about 30 centimetres at Alexandria in fair weather and considerably more in storms.

The effects of this tidal movement, aided by the difference in density between salt and fresh water, is to cause a steady advance of the salt water upstream, principally along the bed of the river, from the time that the outward current of the river fails, and it seems that the river would eventually become more or less salted up to the limit of the tidal oscillations, which is practically the point at which the river bed first rises wholly above sea level. This point is near Nadir, about 30 kilo-

metres south of Kafr-Zayat and 80 north of the Barrage. In heavy storms the tidal uprush is very strong, and the salt water often advances many kilometres a day in bad weather, while the strong currents and eddies occasioned mix up the fresh surface layers with the salter water below, and make the whole mass brackish.

In a little over two months the Mehallet el Amir Sadd was completed, the contractor having had about 100 country boats and over 1,000 men continually at work during that time. But before this was effected the river water was more or less salted, even on the surface, up to beyond Dessuk, and was much too salt for utilization by the pumps at Atfeh.

The river channel was first closed on April 6th, but the Sadd was breached again by a heavy storm on the 8th before it could be strengthened, and was only closed finally on April 13th.

The closing of the final gap in the Sadd was a very troublesome job, not, as is generally supposed, owing to the simple increase in the outward current caused by the contraction of the river's channel (it would take several days for the feeble discharge of the river to cause water to head up appreciably), but owing to the tidal movement producing currents varying incessantly in strength and direction and often of considerable violence.

The Sadd having been completed, the portion of the river above it became practically a reservoir, about 100 kilometres long and 500 metres wide, fresh at its upper end but more or less salted throughout its lower half, most so at the bottom of the channel and just above the Sadd; and the problem was how soonest to freshen the water sufficiently to make it possible to work the Atfeh pumps, which it was assumed (correctly, as it proved) would draw water from the upper layers only.

It was decided in the first instance to keep the Sadd entirely closed and let this reservoir fill up until it was at least high enough to be free from the danger of an incursion of salt water during storms through the escape gap.

This filling up gave the first means of estimating the available discharge of the infiltration water.

From April 21st, when the Sadd was made finally watertight, to May 2nd, when the escape gap was partly opened, the water rose at an average rate of  $4\frac{1}{2}$  centimetres a day, which, assuming the surface area of the reservoir to be as roughly estimated above 50,000,000 square metres, is equal to a discharge of  $2\frac{1}{4}$  millions of metres cube per day.

On May 3rd and 4th the escape was opened out still further, and the water, after dropping a little, remained steady from the 5th with a

constant outward discharge estimated at nearly 3 millions metres cube a day, and certainly well over 2 millions.

There can be little error therefore in estimating the available surplus discharge of infiltration water on this branch of the river, after providing for evaporation and all private pumps, to be about  $2\frac{1}{2}$  millions of metres cube per day in the beginning of May, under the most unfavourable conditions.

During this time the saltiness of the river water at Atfeh diminished slowly but steadily with the constant downward current of the river.

On the 15th May the Atfeh pumps began to work; the effect was immediately apparent in the river level, and the escape gap in the Sadd was wholly closed again on May 21st.

A heavy northerly gale about the same time so stirred up the water of the reservoir that it again became very salt on the surface, and the output of the Atfeh pumps had to be restricted to the discharge of one wheel.

From May 21st to May 31st, one wheel was working, giving a discharge of about 300,000 cubic metres; and, the escape gap in the Sadd remaining closed, the level of the reservoir rose 24 centimetres, corresponding to a supply of about  $1\frac{1}{2}$  millions, but the rather high level of the water must have meant a considerably increased surface area to the reservoirs, and have checked to some extent the action of the infiltration springs.

On June 1st the escape gap was opened fully again to try and run off some of the salted water, and bring the fresh water line down to Atfeh, as the river was known to be sufficiently fresh on the surface a few kilometres above the pumps.

A volume of water estimated roughly at 30,000,000 cubic metres was run off in about ten days, the reservoir falling from 1.19 to 0.90, and the water at Atfeh freshened sufficiently to permit of pumping on a larger scale being started, and from this date (1st June) onwards it was not again seriously interrupted, though the output of the pumps was often temporarily restricted.

The escape gap in the Sadd was finally closed on June 11th, but the inflow had now evidently fallen off considerably, or evaporation and the private pumps were taking much more water, as, with the Atfeh pumps taking steadily 1,000,000 cubic metres a day, the level of the reservoir showed practically no change till the end of June, and then commenced to fall slowly.

The available discharge in the second half of June was therefore about 1,000,000 cubic metres per day.

During the first half of July the reservoir level fell 8 centimetres, corresponding to a diminution of stored water of about 4,000,000 cubic metres, the Atfeh pumps during this time having lifted 14,337,000 cubic metres.

The available discharge in the first half of July was therefore about 690,000 cubic metres per day.

In the second half of July the Atfeh pumps lifted 21,923,000 cubic metres and the store of water diminished by 5,000,000 cubic metres, showing an available discharge of about 1,050,000 cubic metres per day.

The Atfeh pumps continued to work till the 16th August; the river reservoir reached its lowest level, '68 (about 15 centimetres above sea level) on the 29th July, and on the 2nd August the effect of the flood water began to be decidedly felt.

The reservoir filled up in two days and the Sadd had to be cut on the 3rd August, causing a drop in the level at Atfeh from 1'68 to 0'80, which was not made up for ten days, and caused considerable inconvenience owing to the extra strain on the pumps.

We have, therefore, a very perfect record of the supply of infiltration water available for the use of the Atfeh pumps after providing for loss by evaporation, and the private pumps and other water lifting machines on both banks of the river, whose consumption was estimated at about 1,000,000 cubic metres per day in calculating for water distribution, but which probably varied a good deal, and amounted to considerably more than the above figure during the critical month of July.

This available supply was approximately as follows:—

First half of May	... ..	2,500,000 cubic metres.
Second half of May	... ..	2,000,000 (?) ..
First half of June (interpolated)	... ..	1,500,000 (?) ..
Second half of June	... ..	1,000,000 ..
First half of July	... ..	690,000 ..
Second half of July and early days of August	...	1,500,000 ..

As regards the Atfeh pumps themselves, the maximum quantity of water lifted by them in any one day was 1,689,126 cubic metres on the 28th July, though for a considerable time they were endeavouring to lift every cubic metre possible. They lifted over 1,600,000 on several days, and this figure may therefore be taken as about their maximum capacity in their present condition; but, for a period extending

\* The calculated figure is nearer 1,700,000, but the reservoir level was higher during this period than in the others.

over some weeks, an average of 1,500,000 cubic metres per day is quite the most that should be counted on.

The total quantity of water lifted was 84,107,480 cubic metres, and the cost of working the pumps, which depends principally on the price of coal (this year £E.2·09 a ton), amounts to about £E.60 per million cubic metres pumped on the season's working, excluding exceptional items.

There is little doubt but that the pumps are hardly suitable for the heavy lifts under which they were working for a good time this year. The levels ordinarily maintained in the Mahmudiyyeh in the summer nowadays are a good deal higher than what was usual in the days when the Atfeh pumps were the sole source of the canal's supply; and, but that four of the wheels were recently raised 30 centimetres, there would probably have been great difficulty in working at all when the river was at its lowest. As it was, several small accidents occurred owing to the excessive strain thrown on the pumps. The very material saltiness of the river also necessitated great care with the boilers.

The observations made on the saltiness of the river and canal water are particularly interesting.

The saltiness of the sea at Alexandria is 3·940 per cent, that of ordinary canal water about 0·008, and the maximum degree of saltiness permissible in a so-called fresh water canal has hitherto been assumed to be 0·10 per cent.

The saltiness of the river was frequently tested at Atfeh while the sadd at Mehallet el Amir was under construction.

The first serious incursion of salt water took place at the end of February. On the 30th March, after some rough weather, the saltiness of the water reached the high figure of ·506 per cent on the surface, which was the maximum observed; after this the increasing obstruction to tidal movement offered by the sadd and the establishment of a constant though very sluggish downward flow began to be effective.

On the 28th April the first set of observations made at varying depths at one place revealed the fact that the lower layers of the water in the deeper parts of the river were saltier than the surface layers to a much greater degree than was expected.

This state of things continued throughout the season. It was generally found that there was a slight and gradual increase of saltiness from the surface to a depth of about 4 metres, when the water became suddenly intensely salt, being one-half to one-third as salt as the sea itself.

OBSERVATIONS ON SALTNESS OF RIVER AT DIFFERENT DEPTHS.

*At Atfeh.*

	1st May.	15th May.	1st June.	16th June.	1st July.
At surface ...	0·120	0·142	0·159	0·087	0·082
At 1 metre ...	0·132	0·154	0·163	0·090	0·084
At 6 metres ...	2·280	1·020	1·768	1·435	1·680

The following table gives the result of some observations made to see the point up the river to which the salt water reached.

SALTNESS OF THE RIVER AT 1 METRE AND 4 METRES DEPTHS ON DIFFERENT DATES AT VARIOUS PLACES.

	Kafri-Zayat		Shibrakhit.		Dessuk.		Atfeh.		Mehallet el Amir.	
	at 1 m.	at 4 m.	at 1 m.	at 4 m.	at 1 m.	at 4 m.	at 1 m.	at 4 m.	at 1 m.	at 4 m.
9th-12th May ...	·007	·008	·016	·017	·036	·046	·208	·210	·427	·434
23rd-28th May...	·007	·007	·014	·016	·030	·032	·187	·190	·329	·358
7th-8th June ...	—	—	—	—	·023	·028	·084	·098	·283	·297
21st June ...	—	—	—	—	—	—	·993	·098	·360	·360

It is interesting to note that the salt water reached Shibrakhit, but did not reach Kafri-Zayat, and that the water at the latter place, though it must have been almost entirely infiltration water, was no saltier than ordinary Nile water in canals supplied from above the Barrage.

The Sanitary Officer of the Municipality of Alexandria (Dr. Gottschlich) having complained of the increasing saltness of the water soon after the Atfeh pumps commenced to work, it was arranged, after some correspondence, that the saltness of the water in the Mahmudiyyeh Canal at Alexandria should not be allowed to exceed ·05 per cent. or half the old figure, and by carefully regulating the output of the Atfeh pumps in proportion to the saltness of the river and the supply available from other sources, this was effected.

This degree of saltness was, however, declared to be perceptible to the taste by many people; it was noticeable in the incrustations left on the filter tanks of the Alexandria Water Company's works, and had a curious effect in altering the colour of certain kinds of flowers. It was, however, declared by Dr. Gottschlich to be quite unobjec-

tionable on Sanitary grounds, and it is believed that the town of Alexandria was exceptionably healthy at the time its water supply was most noticeably salt, though it is not implied that this was in the nature of cause and effect.

The whole experience seems to furnish a strong argument for a Rosetta Nile Barrage a little below Atfeh; with such a work capable of holding water up to R.L. 3·50, it seems that the Mahmudiyeh Canal could draw its full supply direct from the river (with the Cairo Barrage tightly closed) up till well on in May. The reservoir would hold (independently of the infiltration supply) some 150,000,000 cubic metres of fresh water (above sea level) which could be drawn on to some extent by flow by such canals as the Rosetta, and by pumping for the Mahmudiyeh, at first with a very low and probably always with a moderate lift; the reservoir would also fill up and restore flow supply to all canals below Dessuk by about the 1st August at latest. If the idea of reservoir lakes in Lower Egypt is worth being seriously entertained at all, such a lake as would be formed by the proposed Barrage would be immensely superior in almost every way to any conceivable storage tank that could be formed by banking round areas of low waste land, as has often been suggested.

Then an Atfeh Barrage would also be of great service to navigation by giving deep water in the river at all seasons up to far above Kafr Zayat, and, by the addition of lock connection with the Rayah Behera above Kafr Bulin, would afford a splendid waterway from Cairo to Alexandria, remarkably free from bridge obstructions and regulators.

Of course there are difficulties and objections, but the idea would seem to be at least deserving of careful consideration.

Signed : C. E. DUPUIS,  
*Inspector, 3rd Circle.*





## APPENDICES.



# APPENDIX A.

## ABSTRACT OF ACCOUNTS, 1900—IRRIGATION DEPARTMENT.

### *Lower Egypt.*

BUDGET HEAD.	1st Circle.	2nd Circle.	3rd Circle.	The Barrage.	TOTALS.
	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.	£E. Mill.
<b>REGULAR BUDGET.</b>					
<i>Establishment.</i>					
Classified staff ... ..	9,023,025	8,233,346	8,361,885	1,525,529	27,143,785
Unclassified staff ... ..	4,294,459	3,700,000	3,139,000	2,536,127	13,669,586
Travelling charges. ... ..	3,257,263	3,426,708	3,059,997	51,485	9,795,453
Telegrams ... ..	282,530	267,795	140,000	8,975	699,300
Dahabiyahs... ..	366,400	130,000	132,000	—	628,400
Office charges and furniture ...	419,490	275,230	327,893	10,305	1,032,918
<i>Works.</i>					
New works ... ..	5,691,690	8,998,778	—	5,029,000	19,719,468
Flood protection works ... ..	6,086,023	6,095,500	6,153,259	—	18,334,782
Maintenance and repairs ... ..	4,211,882	4,850,771	3,010,173	13,967,686	26,043,512
Repairs of roads... ..	1,328,158	874,818	500,000	—	2,702,976
Maintenance of drains ... ..	1,499,859	1,250,000	1,500,000	—	4,249,859
Pumping stations ... ..	—	—	10,318,345	—	10,318,345
Corvée abolition works ... ..	30,308,310	25,297,390	36,530,975	—	92,136,675
Totals, Regular Budget.. ...	66,772,089	63,400,336	73,173,527	23,129,107	226,475,059
<i>Corvée Budget.</i>					
Corvée abolition works ... ..	46,000,000	41,999,509	33,999,434	—	121,998,943
<i>Agricultural Roads.</i>					
New roads ... ..	6,421,255	25,036,966	110,111	—	31,568,332
<i>Ferry Fund.</i>					
Bridges to replace ferries... ..	2,080,000	1,875,598	1,028,717	—	4,984,315
<b>SPECIAL GRANTS BY CAISSE FROM GENERAL RESERVE.</b>					
Drainage works... ..	11,029,541	62,850,177	61,350,077	—	168,229,798
Special Low Nile credit ... ..	663,062	3,332,853	7,654,091	—	11,640,006
Mohallet El Amir dam ... ..	—	—	9,408,143	—	9,408,143
Damietta El Amir dam ... ..	4,935,783	—	—	—	4,935,783
Special Dredging Mahmudiyyeh	—	—	3,882,182	—	3,882,182
Weirs below the Barrage ... ..	—	—	—	182,263,320	182,263,320
Totals, other grants... ..	104,129,644	135,085,103	117,432,755	182,263,320	538,910,822
Grand Totals... ..	170,901,733	198,485,439	190,606,282	205,392,427	765,385,881

## APPENDIX B.

### ABSTRACT OF DRAINAGE WORKS EXECUTED IN 1900 IN 1ST CIRCLE.

NAME OF DRAIN.	Length in kilometres.		Earthwork.			Land.			Expenditure on Works.	Total Expenditure.
	New channel.	Re-modelled channel.	Dredging.	Hand-work.	Cost.	Area given.	Area purchased.	Cost.		
			CM.	CM.	£E.	FED.	FID.	£E.	£E.	£E.
BAHR EL BAGAR SYSTEM.										
Main drain... ..	—	25 $\frac{3}{4}$	433,640	—	14,761	—	—	None of the area purchased, for which £E.2,473 is due, was paid for.	—	14,761
Kafr el Azazi branch..	4	9 $\frac{1}{2}$	—	119,112	3,251	3 $\frac{1}{2}$	22		743	3,994
Bordein branch...	—	—	—	—	—	—	—		165	165
Bilbeis branch ... ..	—	—	Due for work done in 1899.						—	1,774
ARIN SAN SYSTEM.										
Um Shok branch ... ..	2	10	—	270,300	3,784	—	50	} 4,501	10,973	
Abu Kebir branch ... ..	6	—	—	15,000	210	3 $\frac{1}{2}$	5			
Um Zamel branch ... ..	11	—	—	177,000	2,478	20	44			
BAHR SAFT SYSTEM.										
Branches ... ..	—	—	—	—	—	—	—	—	1,744	1,744
NIZAM HADUS SYSTEM.										
Main Bahr Tawil ... ..	—	3	72,944	—	2,480	—	—	—	—	2,480
Mansurah branch ... ..	6 $\frac{1}{2}$	4	—	171,500	2,068	37	6 $\frac{1}{2}$	—	193	2,261
Bahr Shobak and Galayla..	10	19 $\frac{1}{4}$	—	204,232	3,433	28 $\frac{1}{2}$	—	—	1,230	4,663
SIRC SYSTEM.										
Sayala & Bashmur branches	—	—	Due for work done in 1899.					—	—	105
MISCELLANEOUS.										
Land ... ..	—	—	—	—	—	—	—	—	—	724
Staff and sundries ... ..	—	—	—	—	—	—	—	—	—	2,129
TOTALS ... ..	39 $\frac{1}{2}$	71 $\frac{1}{2}$	506,584	957,144	32,465	92 $\frac{1}{2}$	127 $\frac{1}{2}$	—	8,576	45,773

# APPENDIX C.

## DETAIL OF EXPENDITURE ON WORKS.

NAME OF DRAIN.	DESCRIPTION OF WORK.	EXPENDITURE.		TOTALS.
		£E.	£E.	£E.
BAHR EL BAGAR SYSTEM.				
Kafr el Azazi branch ...	20 pipe aqueducts ... ..	614		743
	6 wooden bridges ... ..	120		
	Kilometre marks and compensation for crops... ..	9		
Bordein branch ... ..	2 regulators on Tarturiyah and Domshushiyah Canals ... ..	165		165
ARIN SAN SYSTEM.				
Main drain... ..	Railway bridge ... ..	1,120		1,603
	Agricultural road bridge... ..	267		
	Diversion, compensation & sundries.	316		
Branches ... ..	49 pipe aqueducts ... ..	1,870		3,320
	29 wooden bridges ... ..	1,450		
			4,923	4,501
	Deduct balance yet to be paid...		422	
BAHR SAFT SYSTEM ... ..	Bridges and regulators ... ..	—	—	1,744
NIZAN HADUS SYSTEM.				
Mansura branch ... ..	9 pipe aqueducts ... ..	—	223	
	10 wooden bridges ... ..	—	180	
	12 kilometre marks ... ..	—	5	
			818	193
	Deduct balance yet to be paid...		225	
Bahr Shobak and Galayla.	12 pipe aqueducts ... ..	—	806	1,230
	14 wooden bridges ... ..	—	404	
	42 kilometres marks... ..	—	20	
				1,230
		Total... ..		8,576

## APPENDIX D.

ABSTRACT OF DRAINAGE WORKS EXECUTED IN 1900 IN THE 2ND CIRCLE.

[illegible]

## APPENDIX E.

DETAIL OF "EXPENDITURE OF WORKS" COLUMN OF PRECEDING TABLE.

NAME OF DRAIN OR IRRIGATION CHANNEL.	DESCRIPTION OF WORK.	EXPENDITURE.	TOTAL.
		£E.	£E.
BAHR SHIBIN SYSTEM.			
Muhit drain ... ..	Erecting of pipe aqueducts ... ..	458.010	458.010
Demellash drain ... ..	Planting banks to prevent sand encroach- ment ... ..	72.962	
Sarana canal ... ..	1 constructing head sluice... ..	348.486	348.486
BAHR MULLAH SYSTEM.			
Alamyah drain. ... ..	{ 3 wooden bridges.. ... .. } 11 pipe aqueducts.. ... ..	393.442	843.442
Samatay drain and branches ... ..		22 light wooden bridges ... ..	
Samoul canal... ..	1 constructing head sluice... ..	248.324	248.324
Ganabiyah Tombara East ... ..	1 regulator and 1 pipe escape ... ..	208.825	208.825
WAZIRIYAH SYSTEM ... ..	1 pipe syphon ... ..	200.000	200.000
ARIAMUN SYSTEM.			
Shalmah canal.. ... ..	1 head sluice (past payment) ... ..	211.460	211.460
Ariamun... ..	4 head sluices (past payment) ... ..	167.210	
NASHART SYSTEM.			
Nashart drain... ..	{ 10 timber supports for pipe aqueducts ... Head sluices for Ganabiyahs above Kal- line regulator.. ... .. Culvert under Tanta-Dessuk railway ... Culvert under Kalline-Sherbine railway.	26.901	2,017.126
		105.285	
		963.330	
		1,011.610	
Bahr Sheikh Ibrahim ... ..	1 navigable head sluice ... ..	809.817	809.817
{ 18 W.I. pipes for syphons and aqueducts East Ganabiyah Sidi Salem.. ... .. 1 cement armé syphon on East Gana- biyah Sidi Salem ... .. 1 pipe head for Khor Abu Dukhan Bahr Nashart ... ..	167.598		
	674.950		
	70.538		
Carried over... ..			5,585.462



DETAIL OF "EXPENDITURE OF WORKS" COLUMN OF PRECEDING TABLE—(continued).

NAME OF DRAIN OR IRRIGATION CHANNEL.	DESCRIPTION OF WORK.	EXPENDITURE.	TOTAL.
		£ E.	£ E.
	<i>Brought forward...</i>		5,585,662
Irrigation channels, Nashart projects ... ..	10 pipe head for west branch Bahr Sheikh Ibrahim ... ..	89,800	
	W.I. pipes for West Ganabiyah Zeni ...	450,640	
	Sluice doors and gearing for pipe heads and regulators on Ganabiyahs Zeni. Khalig Ahmar, Bahr Sheikh Ibrahim.	1,358,064	
	Lengthening 2 bridges East Ganabiyah Sidi Salem ... ..	25,000	
	16 wooden bridges ... ..	352,920	
	1 pipe syphon and revetments Bahr Sheikh Ibrahim junction channels... ..	304,537	
	Revetments to Zeni Ganabiyah.. ...	11,000	
	115 pottery-pipe outlets ... ..	166,470	
			3,671,517
	3 pipe syphons ... ..	68,880	
Um Yusef drain ... ..	34 supports for pipe aqueducts... ..	77,384	
	Culvert under Tanta-Dessuk railway (part) ... ..	1,010,000	
	Arrears for Ghenemi canal syphon... ..	85,277	
			1,241,541
Shaba drain and branches ...	1 pipe syphon for Ebtoo canal... ..	169,013	
	55 pipe aqueducts.. ...	1,348,261	
	8 wooden bridges.. ...	960,800	
	Ciment armé syphon for Shaba canal ...	366,680	
Shaba canal ... ..			2,844,754
	Constructing head sluice ... ..	207,516	
			207,516
Hod El-Hagar drain & branches ... ..	Masonry syphon under Koddaba canal...	1,407,419	
	Masonry syphon under Sanhur canal railway ... ..	2,812,700	
	2 masonry syphons ... ..	2,129,050	
	Pipe aqueducts, syphons and outlets ...	1,463,781	
	12 timber and masonry bridges.. ...	1,102,170	
	2 wooden bridges ... ..	142,500	
	Repairing three old bridges ... ..	57,000	
	1 masonry culvert ... ..	87,480	
			9,202,100
Bagoura drain.. ...	Pipe syphons and aqueducts ... ..	506,770	
	1 timber bridges... ..	179,000	
			685,770
Commission drain... ..	Pipe aqueducts ... ..	220,770	
	2 timber bridges... ..	88,750	
			309,520
Sunhur drain and branches...	Pipe aqueducts ... ..	1,226,310	
	Pipe syphons ... ..	306,388	
	7 timber and masonry bridges... ..	45,705	
	1 timber bridge ... ..	77,480	
			1,655,883
	TOTAL... ..		25,494,263

## APPENDIX F.

### ABSTRACT OF EXPENDITURE ON DRAINAGE WORKS EXECUTED IN 1899 IN 3RD CIRCLE.

NAME OF DRAIN.	Length in kilometres.		Earthwork including dredging.		Land.			Expenditure on Works.	Total Expenditure.
	New.	Remodelled.	Cube.	Cost.	Area purchased.		Cost.		
			C.M.	£E.	F.	K.	£E.	£E.	£E.
<b>EDKU SYSTEM.</b>									
Edku ... ..	—	—	16,834	505	—	—	—	—	505
Khandak Gharbi ... ..	3·6	—	28,127	658	—	—	—	552	1,210
Shibrakhit ... ..	10·1	—	102,089	1,946	—	—	—	2,501	4,446
Miniet Salam ... ..	6·0	—	67,034	1,006	4	—	77	713	1,796
Lakana ... ..	3·7	—	26,017	390	—	12	5	185	580
<b>MAREOTIS SYSTEM.</b>									
Umum ... ..	—	—	382,093	10,121	—	—	—	1,524	11,645
Shereishra ... ..	—	0·8	327,342	7,811	—	—	—	209	8,020
Abu Hommos ... ..	17·6	16·4	251,273	4,509	29	—	562	2,392	7,463
Safar (Dessunes) ... ..	8·1	—	111,563	1,960	—	—	—	401	2,362
Nubarieh ... ..	3·0	—	49,266	1,133	—	—	—	84	1,217
Zahrah ... ..	3·7	—	22,210	333	5	12	75	310	718
Deshuri ... ..	—	—	—	—	—	—	—	248	248
Mex Pumps ... ..	—	0·3	22,250	623	—	—	—	2,449	3,072
<b>MISCELLANEOUS.</b>									
Staff and Sundries ... ..	—	—	—	—	—	—	—	—	4,892
Land payments for lands occupied by drains made in preceding years ... ..	—	—	—	—	202	12	3,625	—	3,625
Totals ... ..	55·8	17·5	1,406,118	30,995	241	12	5,344	11,568	51,799

# APPENDIX G.

DETAIL OF "EXPENDITURE ON WORKS" COLUMN OF PRECEDING TABLE.  
3rd Circle.

NAME OF DRAIN.	DESCRIPTION OF WORK	EXPENDITURE.	TOTAL.
		£E.	£E.
Khandak Gharbi ... ..	3 aqueducts... ..	122	552
	2 drainage pipe inlets ... ..	50	
	1 timber bridge ... ..	380	
	3 masonry culverts ... ..		
Shibrakhit ... ..	35 aqueducts ... ..	1,253	2,501
	5 syphons ... ..	1,094	
	3 timber bridges ... ..	154	
Miniet Salama ... ..	12 aqueducts ... ..	417	713
	2 syphons ... ..	296	
Lakana ... ..	3 aqueducts ... ..	71	185
	1 drainage pipe inlet ... ..	56	
	3 timber bridges ... ..	58	
	Kilo marks, boundary stones, etc. ...		
Umum ... ..	1 pipe and masonry syphon ... ..	762	1,524
	1 pipe syphon ... ..	264	
	4 timber bridges ... ..	373	
	12 drainage pipe inlets ... ..	125	
Shereishra ... ..	2 pipe aqueducts ... ..	15	209
	8 timber bridges ... ..	132	
	19 drainage pipe inlets ... ..	62	
Abou Hommos ... ..	19 aqueducts ... ..	860	2,362
	6 syphons ... ..	1,033	
	13 bridges ... ..	499	
Safar (Dessunes) ... ..	1 aqueduct ... ..	175	401
	3 syphons ... ..	140	
	3 bridges ... ..	86	
Nubarieh ... ..	2 timber bridges ... ..	84	84
Zahrah ... ..	12 aqueducts ... ..	157	310
	1 syphon ... ..	49	
	3 drainage pipe inlets ... ..	42	
	3 bridges ... ..	62	
Deshuri ... ..	1 iron pipe syphon ... ..	248	248
Mex pumps... ..	Brick chimney ... ..	277	2,449
	Remodelling water supply ... ..	1,965	
	Paving boiler house ... ..	207	
Total... ..		—	11,568

## APPENDIX H.

### STATEMENT OF PRINCIPAL WORKS OF IRRIGATION IMPROVEMENT EXECUTED IN THE 3RD CIRCLE DURING 1900.

	£E.	£E.
(1) WIDENING THE SAHEL MERQAS CANAL.		
Widening about 7 kilometres of the canal with the remodelling of two bridges and 30 irrigation outlets ... ..	7,254	7,254
(2) IRRIGATION IMPROVEMENT WORKS IN GIZEH PROVINCE.		
Two three-arch regulators at Bedresheyn ... ..	1,984	
Four two-arch regulators at Ghamaza (2), Tourah (1) and Zummur canal head (1) ... ..	3,855	
Abu Nimrus syphon (two pipes of 2 metres each) ... ..	4,166	
Zummur and Ghamaza syphons (pipes of 2 metres and 1·5 metres respectively) ... ..	2,460	
Seven small regulators at Abu Qagwan (2), Azizia (1), Sheikh Uthman (1), Nasr el Din (1), Manshiyah (1) and Zummur canal tail ... ..	2,685	
Construction of 14·6 kilometres of Gizeh Canal extension (1·0 at Kafr Amar and 13·6 below Bedresheyn) with four bridges (Kafr Amar, Bedresheyn, Sheikh Uthman and Geziret el Dahab) and seventy pipe outlets ... ..	8,410	
Conversion of Sakkara and Ghamaza regulators from vertical to horizontal system of regulation with through repair to old work ... ..	924	
Purchase of pipe for Rayah Behera syphon ... ..	483	
Total Gizeh Works ... ..		24,967
(3) MISCELLANEOUS.		
Purchase of kilo-marks, boundary stones, tents, marble gauges, etc.	550	550
Total Irrigation Improvement Works ... ..		32,771

# APPENDIX K.

## NILE GAUGES FOR THE YEAR 1900.

DATE.	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	Aswân.	Rosetta.	Aswân.	Rosetta.	Aswân.	Rosetta.	Aswân.	Rosetta.	Aswân.	Rosetta.	Aswân.	Rosetta.	Aswân.	Rosetta.	Aswân.	Rosetta.	Aswân.	Rosetta.	Aswân.	Rosetta.	Aswân.	Rosetta.	Aswân.	Rosetta.
1	3 5	11 00	1 18	13 50	1 0	13 52	0 1	13 11	0 1	12 08	1 18	13 30	7 8	15 46	15 20	16 39	11 6	16 16	9 1	15 51	6 12	11 50		
2	3 3	11 00	1 17	13 50	0 23	13 52	0 0	13 10	0 6	12 07	1 19	13 34	8 2	15 50	15 18	16 10	11 3	16 17	9 1	15 41	6 11	11 50		
3	2 23	11 00	1 16	13 50	0 22	13 50	0 3	13 17	0 8	12 07	1 19	13 37	8 20	15 50	15 14	16 10	11 0	16 17	8 22	15 46	6 0	11 50		
4	2 23	13 14	1 16	13 50	0 22	13 50	0 2	13 13	0 0	12 06	1 20	13 13	9 14	15 50	15 8	16 39	11 1	16 14	8 19	15 40	6 8	11 55		
5	2 23	13 54	1 15	13 50	0 22	13 50	0 2	13 39	0 0	12 05	1 21	13 16	10 20	15 50	15 2	16 39	11 1	16 11	8 15	15 28	6 7	11 58		
6	2 22	13 50	1 15	13 50	0 21	13 43	0 1	13 43	0 1	12 05	1 22	13 50	12 6	15 50	15 0	16 37	11 3	16 06	8 12	15 21	6 5	11 58		
7	2 20	13 50	1 15	13 80	0 20	13 80	0 1	13 41	0 1	12 05	1 23	13 51	13 0	15 50	14 12	16 30	13 20	15 00	8 8	15 38	6 1	11 58		
8	2 18	13 50	1 11	13 80	0 20	13 50	0 0	13 45	0 1	12 05	2 0	13 57	13 15	15 50	14 17	16 30	13 20	15 00	8 5	15 50	6 1	11 50		
9	2 17	13 50	1 13	13 80	0 19	13 43	0 1	13 43	0 1	12 05	2 6	13 61	14 12	15 50	14 12	16 22	13 17	16 02	8 3	15 50	6 1	11 50		
10	2 16	13 50	1 12	13 80	0 18	13 39	0 1	13 39	0 0	12 05	2 6	13 63	15 1	15 50	14 8	15 17	13 11	16 11	8 1	15 50	6 3	11 50		
11	2 16	13 50	1 11	13 80	0 17	13 40	0 1	13 40	0 0	12 05	2 11	13 62	15 8	15 50	14 1	16 13	13 12	16 18	7 22	15 50	6 1	11 50		
12	2 15	13 50	1 10	13 80	0 17	13 40	0 2	13 39	0 2	12 02	2 20	13 66	15 12	15 50	11 2	16 01	13 2	16 25	7 19	15 50	5 23	11 40		
13	2 12	13 50	1 9	13 80	0 16	13 37	0 3	13 37	0 2	12 02	3 17	13 66	15 12	15 50	11 2	16 01	13 2	16 25	7 11	15 50	5 19	11 31		
14	2 10	13 50	1 8	13 80	0 15	13 35	0 3	13 35	0 3	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 20	7 13	15 50	5 19	11 33		
15	2 9	13 50	1 7	13 80	0 13	13 31	0 1	13 31	0 1	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 18	11 33		
16	2 8	13 50	1 6	13 80	0 12	13 28	0 1	13 28	0 1	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 18	11 33		
17	2 7	13 50	1 5	13 80	0 11	13 27	0 2	13 27	0 2	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
18	2 6	13 50	1 5	13 80	0 10	13 26	0 1	13 26	0 1	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
19	2 6	13 50	1 5	13 80	0 9	13 26	0 1	13 26	0 1	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
20	2 5	13 50	1 4	13 80	0 8	13 26	0 3	13 26	0 3	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
21	2 4	13 50	1 3	13 80	0 8	13 26	0 3	13 26	0 3	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
22	2 4	13 50	1 3	13 80	0 7	13 26	0 3	13 26	0 3	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
23	2 3	13 50	1 3	13 80	0 7	13 26	0 3	13 26	0 3	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
24	2 2	13 50	1 2	13 80	0 7	13 26	0 3	13 26	0 3	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
25	2 0	13 50	1 2	13 80	0 7	13 26	0 3	13 26	0 3	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
26	1 22	13 50	1 2	13 80	0 7	13 26	0 3	13 26	0 3	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
27	1 22	13 50	1 1	13 80	0 6	13 26	0 3	13 26	0 3	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
28	1 21	13 50	1 0	13 80	0 6	13 26	0 1	13 26	0 1	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
29	1 21	13 50	1 0	13 80	0 6	13 26	0 1	13 26	0 1	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
30	1 20	13 50	1 0	13 80	0 6	13 26	0 1	13 26	0 1	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		
31	1 19	13 50	1 0	13 80	0 5	13 26	0 1	13 26	0 1	12 00	3 20	13 70	15 15	15 50	11 5	15 07	12 10	16 22	7 12	15 50	5 17	11 33		

P.K. = P.O.S. Khartoum—U.S. = Upstream R.L.

# APPENDIX L.

TABLE OF PUMP AND SAKIEH DISCHARGES AND THE AREAS PROTECTED BY MACHINES OF VARIOUS SIZES.

MACHINE.	Approximate discharge in cubic metres for 24 hours.	Equivalent number of single sakiehs.	Area watered per day at 350 <sup>mm</sup> per feddan.	Area protected with a six-day rotation period assuming one-third of the area under set crops.	Area protected with a six-day rotation period assuming 40 per cent of the area under set crops.	REMARKS.
	metres cube.	single sakiehs	feddans.	feddans.	feddans.	
Single sakieh	300	1	8	15	12	The area irrigated by a sakieh depends chiefly on the lift and the strength of the bullocks employed; the figures here given are to suit the usual conditions on canals in Lower Egypt.
Double sakieh	600	2	17	30	25	
4" pump...	1,248	4	35	63	53	
5' " ...	2,366	8	67	120	100	
6' " ...	3,408	11	10	174	145	
7' " ...	4,815	16	14	246	205	
8' " ...	6,528	22	19	336	280	
10' " ...	10,200	34	29	522	435	
12' " ...	14,688	49	42	753	628	
14' " ...	19,992	67	57	1,026	855	
15" " ...	22,994	76	65	1,176	980	The area irrigated by a pump in good order is practically independent of the lift, provided that the available Engine power is sufficient under all conditions.
16' " ...	27,648	92	79	1,419	1,183	
18' " ...	34,992	117	100	1,794	1,495	
20' " ...	43,200	144	123	2,217	1,848	
24' " ...	62,208	207	177	3,192	2,660	
30' " ...	97,200	324	277	4,986	4,155	

## APPENDIX M.

### NOTE.—MAKING A COMPARISON BETWEEN THE RIVER DISCHARGES OF THE YEARS 1889 AND 1900 DURING LOW NILE.

Before attempting a comparison, it is necessary to find the correction to be applied to the 1900 Aswan readings to make them accord with those of previous low years.

On page 25 of the Irrigation Report for 1890 the minimum river discharge at Cairo, as taken on 16th and 17th June, 1890, by addition of the six measured Canal discharges, is given as 20 millions a day, or 231 cubic metres a second. The discharges were taken by M. Roux.

On 13th June, 1900, the discharge at Cairo, measured in the same way by Mr. West, was 19 millions a day or 220 cubic metres a second.

Now the minimum level at Aswan of 1890 was 84'40, which is precisely the level that gives a discharge of 231 cubic metres a second, or 20 millions a day, according to the table on page 45 of Willcock's Egyptian Irrigation, 2nd edition.

Mr. Willcock's states (presumably on the strength of observations made when he was Director-General of Reservoirs) that the infiltration between Aswan and Cairo balances what is taken out on the way by pumps and the Ibrahimiyeh Canal; so that the discharge at Cairo becomes the same as that at Aswan on the corresponding date. This statement is borne out exactly by the measured minimum discharge at Cairo and the recorded levels at Aswan in 1890, as shown above.

But since 1890, more pumps have been added between Aswan and Cairo, at Nag-Hamadi, Baliana, Sheikh Fadl and Kafr Ammar. Probably 10 cubic metres per second fully represents the increase. The Ibrahimiyeh Canal also in 1900, in consequence of the temporary conditions at its intake, obtained a better supply than in 1890: which increase we may also put at 10 cubic metres a second.

The minimum discharge at Aswan in 1900, therefore would be

$$220 + 10 + 10 = 240 \text{ cubic metres a second.}$$

The level at Aswan corresponding with this discharge is (from the Table) 84'43. The minimum level at Aswan was actually 84'07.

The correction, therefore, we desire to obtain, is 36 centimetres, or 16 *kirats*.

That is, to convert the 1900 Aswan readings into figures in accord with previous years, 36 centimetres must be added to them.

We have another way of calculating this correction from the observed discharges of 1900 during the lowest period when the discharge of the river was fairly constant. The following figures give the calculation:—

DATE.	Measured discharge at Cairo c.m. a second.	Discharge at Cairo + 20 c. m. a sec. = Discharge at Aswan.	Level at Aswan corresponding to discharge from Table.	Actual recorded level at Aswan 19 days before date of col. 1.	Difference in observed and calculated levels.
14 May...	238	258	84'49	25 April 84'12	:37
22 „ ...	234	254	84'48	3 May 84'16	:32
30 „ ...	234	254	84'48	11 „ 84'16	:32
7 June...	233	253	84'48	19 „ 84'14	:34
13 „ ...	222	242	84'44	25 „ 84'10	:34
Mean... ..					:34

The former figure found was '36, so we might take '35 as the correct figure.

But we will, nevertheless, take the higher figure '36, and adding this to the 1900 readings, compare with 1889, the worst year of which we have any record previous to 1900.

The average levels at Aswan of the different months in the two years were as follows:—

YEAR.	January.	February.	March.	April.	May.	June.	1st half of July.
1889	86.19	85.51	84.95	84.66	84.50	84.55	85.72
1900	85.45	84.85	84.45	84.14	84.13	84.63	85.45
Correction.	'36	'36	'36	'36	'36	'36	'36
Corrected..	85.81	85.21	84.81	84.50	84.47	84.99	85.81

The corresponding discharges at Aswan and Cairo were, therefore :

Year	January	February	March.	April.	May	June.	1st half of July
Aswan.							
1889 ...	925	614	385	308	260	275	698
1890 ...	735	494	353	260	251	407	735
Cairo (19 days later than Aswan).							
1889 ...	925	614	385	308	260	275	698
1900 ...	715	474	333	240	231	387	695

The summer supply may be taken to extend from 1st March to 15th July at Aswan, and for a corresponding period nineteen days later at Cairo.

The *average* discharges for these periods were as follows :

	At Aswan					At Cairo.
1889 ...	...	...	...	...	128	128
1900 ...	...	...	...	...	116	119

The cotton crop depends on the discharge at Cairo. The Ibrahimiyeh discharge was much better in 1900 than in 1889, and this improvement in Middle Egypt and the Fayum was at the expense of Lower Egypt.



The foregoing figures show that, up to the end of May at Aswan and up to the 19th June at Cairo, the 1900 discharges were constantly less than the discharges of 1889: but that the discharges of June at Aswan, and of the period from 20th June to 20th July at Cairo, the 1900 discharges were better than those of 1889. For the first half of July the discharges at Aswan were slightly better than those of 1889, but for the last 10 days of July the corresponding discharges at Cairo were the same for both years.

As far, therefore, as Lower Egypt was concerned, it is perfectly accurate to state that the summer supply of 1900 was worse than that of 1899, though not so much so as the uncorrected levels of the Aswan gauge would lead one to suppose. The worst feature of the 1889 summer was the continuance of low levels at Aswan up to nearly the end of June.

Under such circumstances, as no measures were taken in 1889 to prohibit the irrigation of Sharaki lands for durah till the supply was sufficient to safely permit of it, it is easy to understand why the crop of 1889 was so much shorter than that of 1900, even were continuous improvements in irrigation and drainage channels, greater control over distribution given by the large number of new works built, a severe and better observed programme of rotation, and accumulated experience to count for nothing.

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REPORT ON THE NILE RESERVOIR WORKS,

1900

BY

A. L. WEBB,

*DIRECTOR GENERAL OF RESERVOIRS.*



## REPORT ON THE NILE RESERVOIR WORKS, 1900.

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1.—Although the reports of previous years have given a detailed history of the Project and a full description of the works, still a brief summary is necessary in order to make this report more intelligible.

As my connection with the works only commenced after the completion of the season's operations, it has been necessary in writing this report to draw largely on the reports of Messrs. Fitzmaurice & Stephens, the resident Engineers of the Aswan Dam and Asyut Barrage respectively, from which much that follows is given verbatim.

The works consist of the following :—

- (a) A dam and navigation channel at Aswan.
- (b) A barrage and lock at Asyut.
- (c) A regulator and lock at the head of the Ibrahimiyah Canal at Asyut.

### THE ASWAN DAM.

#### *History of the Project.*

2.—The preliminary studies and the preparation of the various projects for a Reservoir were made by Mr. Willcocks, C.M.G., during the four years 1890-1893.

The several projects were submitted to Sir William Garstin, K.C.M.G., Under Secretary of State, who, while giving his opinion in favour of the Aswan site, proposed that the whole question should be referred to an International Commission consisting of Sir B. Baker, K.C.M.G., Signor Giacomo Torricelli, and Mr. Auguste Boulé.

As a result of these investigations it was decided to construct a dam to hold up water to R.L. 114 across the head of the Aswan Cataract to the north of the island of Philæ, the Commission being of opinion that this was the only site that appeared to offer the necessary conditions of solid rock foundations, width of waterway, facility of construction and sufficient storage capacity.

Finally, so as not to submerge the temples on the island of Philæ, a revised project was prepared by Mr. Willcocks, C.M.G., then Director

General of Reservoirs, for a dam to hold up water to R. L. 106, adopting modifications proposed by Sir Benjamin Baker and Signor Torricelli. It is this project which is now being executed.

On the 21st February, 1898, a contract was signed by H. E. Hussein Fakhry Pasha, Minister of Public Works, and Messrs. John Aird & Co. by which the latter undertook to construct the dam and connected works for the sum of £E.2,000,000, payment being made by sixty half-yearly instalments of £E.78,613, commencing on the 1st July, 1903, the date fixed for the completion of the works.

The late Mr. W. J. Wilson then became Director General of Reservoirs.

### *Description of the Dam.*

3.—As already stated, the dam is to hold up water to a level of 106 metres above mean sea level, the lowest level on the downstream side being 86 metres above mean sea level. The greatest head on the dam will therefore be 20 metres. The storage capacity is estimated at 1,065,000,000 cubic metres. The reservoir will be filled between December and March after the flood has passed, and will be discharged during May, June and July.

The dam will be pierced by 140 under sluices of 14 square metres area each, and by 40 upper sluices of 7 square metres area each. In flood the sluices will be fully open so as not to appreciably lessen the velocity of the river and thus cause a deposit of silt. After the flood, when the water has become clear, the sluices will be gradually closed and the reservoir filled: in an average year the reservoir will be full by the 1st March. At that time some of the upper sluices only will be open to pass the discharge coming from the south, the water level in the reservoir being maintained at R.L. 106. In May, when the demand for water for the summer crops increases, the sluices will be gradually opened so as to supplement the supply in the river, and the reservoir will gradually be discharged until about 1st July, when all the sluices will be fully open to pass the discharge of the Nile flood.

The dam is straight from end to end, and the length will be about 2,000 metres. Its width at top (R.L. 109) will be 7 metres and the deepest part 25 metres. The height from the deepest part of the foundation to the top will be 40 metres. The interior masonry is rubble granite in 4 to 1 cement mortar, and the interior casing is of large squared rock faced granite in 2 to 4 cement mortar. The lining of the sluices is either heavy granite ashlar or cast-iron. The sluices





ASSUAN, DAM VIEW LOOKING EAST.







D. G. ROBERTS

ASSUAN DAM. CAST IRON LININGS.





ASSUAN DAM, DOWNSTREAM

will be closed by steel gates, and the greater number will work on free rollers suspended in frames on the system designed by the late Mr. F. G. Stoney.

On the left flank of the dam there will be a canal about 2,000 metres long provided with 4 locks, each 70 metres long and 9.50 metres wide, so that navigation, which at present is only possible with difficulty at high Nile, may be continued all through the year. The bed of the navigation channel upstream of the locks will be at R.L. 90 and downstream at R.L. 83. The gates will slide into recesses in the sides of the locks. There will be two gates 18 metres high, one 14 metres, one 11 metres and one 8 metres.

The rock on which the dam is built is granite, but at several points it has been found to be rotten for a considerable depth.

#### *Work during year 1898.*

4.—The preliminary works required were commenced in April, 1898, and while the necessary plant and materials were being brought on the ground, a commencement was made with the excavation on the east end of the dam and in the navigation channel. The total excavation done on the line of the dam during the year was 21,399 cubic metres. Although the actual amount of permanent work carried out during the year was small, very valuable work was done as regards observations and surveys of the different channels and the surrounding country both during low Nile and flood.

#### *Work during year 1899.*

5.—During the year 1899 excavation was completed for a length of 685 metres from the east end of the dam, and for a length of 55 metres in the Mohamed Ali island; at other parts of the dam excavation was in progress over an aggregate length of 600 metres. The total quantity of excavation done during the year was 100,212 cubic metres.

The foundation stone of the dam was laid on February 12th, 1899, by H.R.H. The Duke of Connaught. The total quantity of masonry laid during the year was 74,703 cubic metres.

Very considerable work was also done during this year in connexion with the "saddles" or temporary dams across three out of the five deep channels of the river, which cross the line of the dam and carry the supply of the Nile during winter and summer. These channels are known as the Bab-el-Kebir, Bab-el Haroun and Bab-el-Soghayar, and

the fall through them from about 100 metres above to an equal distance below the axis of the dam was about 3 metres at low Nile. These are the first rapids of the Aswan Cataract, and the total fall in the river from Philæ to Aswan was about 5 metres before the regime of the river was disturbed by these works.

The method adopted for dealing with these deep channels was to construct "saddles" across them upstream and downstream of the site of the dam; these saddles were then made sufficiently water-tight to allow of the area between them being laid dry by pumping.

It is necessary to make the saddles on one side of the dam of stone so as to stand the great rush of water. After the stone saddles are made and the rush of water is stopped the saddles on the other side of the dam can be constructed of sand in bags.

It was decided to make the stone saddles on the north side of the dam, and this work was commenced in March and finished in July. An account of the details of the construction of these saddles has been given in the report for 1899. The level of the saddles was 5 metres below high Nile, so that they had to be made strong enough to stand the Nile flood rushing over them. The object of their construction before high Nile was to obtain still water early in the following season upstream of the saddle, so that a sand-bag saddle could be commenced on the other side of the dam as soon as the water level fell to the top of the stone saddles. After the flood the water level fell low enough to allow the sand-bag saddles to be commenced on the 7th November, and the three channels were closed by the end of the year.

#### *Work during year 1900.*

6.—A programme of work for the year 1900 was drawn up in October, 1899, and it was then decided that every effort should first be made to get in the foundations in the Babel Kebir during the year, and that, if possible, the foundations in the two smaller channels, the Bab-el-Haroun and Bab-el-Soghayar, should also be completed. The extraordinary low flood of 1899 followed by a rapidly falling river gradually gave hopes that it might be possible to exceed even this programme, and it was decided to attempt to get in the foundations in the wide central channel of the Nile in addition to those in the channels already mentioned. The saddles were, therefore, continued across this channel, the water was completely shut off on February 20th, and the whole discharge of the Nile sent down the west channel. The stone saddles on the north side of the dam were, as a rule, 7 metres wide on top with

slopes of about 1 to 1, and the greatest depth was 15 metres. The R.L. of the top of the sadds was 93.50. When the whole discharge of the Nile was sent down the west channel the water below these sadds fell away, leaving the bed of the river dry for nearly the whole length of the sadds, and where this did not happen a small subsidiary sand or clay sadd was made below the stone sadd. It was not, therefore, necessary to make the stone sadds water-tight. The amount of stone used in these four sadds was about 60,000 cubic metres.

As the stone sadds had to stand the full force of the water rushing down the cataract it was very difficult to close them. The general method adopted was to put in large stones up to about 4 tons in weight one by one with a crane; but even stones of this size were sometimes carried away at once by the rush of the water. In some cases wire nets full of stone were put in with a crane, and when the net did not move after being dropped into place this method was effective, but if there was any movement the wire netting got cut and the stones fell out.

The stone sadd in the Bab-el-Kebir was closed under a head of 2 metres. Great difficulty was experienced in closing the sadd in the Bab-el-Soghayar, but it was eventually done under a head of 3 metres by running in bodily two large railway wagons filled with stone in wire nets which were fastened to the body of the wagon with steel ropes: each of these wagons with contents weighed 25 tons, and formed a toe against which large stones could be placed.

The sand-bag sadds on the south side of the dam were 5 metres wide on top with slopes of about  $1\frac{1}{2}$  to 1, and the greatest depth was 17 metres; the top was kept at R. L. 93.50. These sadds were staunch by throwing sand and stone chippings on the up-stream side where the slope eventually became 2 to 1. The sand used was a heavy granite sand, sixteen bags of which went to one cubic metre. The maximum head of water on the sadds was about 10 metres, and they were remarkably tight, the leakage through the sadds in the Bab-el-Kebir being kept down by one 12-inch centrifugal pump working about one quarter time.

Six 12-inch centrifugal pumps were started in the Bab-el-Kebir on the 9th January and the channel was dry by 10 o'clock that night. At the Bab-el-Haroun one 6-inch pump dealt with all the water, and two 6-inch pumps were required in the Bab-el-Soghayar. By the end of January excavation was going on all over these three channels.

Pumping was commenced in the Central Channel on February 28th with one 12-inch centrifugal pump. The water was quickly pumped out and the excavation commenced early in March. After the water was pumped out in the channel one 8-inch centrifugal easily dealt with the leakage.

Regarding the progress of the work Mr. Fitzmaurice writes as follows:—

By the first week of March, therefore, every thing was getting on very well and satisfactorily. Excavation was in full swing along the four channels, and masonry had been commenced in the Bab-el-Haroun. Over a long length of the excavation the rock, however, was not found to be very solid, and this was particularly the case in the Bab-el-Kebir and Bab-el Soghayar. By the end of March the excavation in the former channel had been carried down to R.L. 73·00 or 9 metres lower than the level of solid rock shown on the contract drawings, and at the latter channel the excavation had reached R.L. 79·00 or 4 metres below contract level of solid rock. By the end of April solid rock had not been obtained in either channel. It was now only three months before all work for the season would have to be suspended on account of the Nile flood, and before that time the masonry had to be brought up to R.L. 94·00 or the sadds would have to be reconstructed the next season. Still it would be better to incur the expense of re-constructing sadds than to have any doubt about the foundation: the excavation was therefore continued. During the first week of May the bottom got better, and on May 10th the masonry was commenced in the Bab-el-Kebir, and on May 26th in the Bab-el-Soghayar. In the former case the foundation level was R.L. 70·50 or  $11\frac{1}{2}$  metres below the level of rock shown in the contract drawings. The masonry in this channel had now to be built for a height of 24 metres in  $2\frac{1}{2}$  months and as many masons as could possibly work together were put on here. In the meantime at the Central Channel bad rock was found in many places, and the final level of the foundation was about an average of 2 metres deeper than had been anticipated, and it was not until early in May that masonry was commenced. On the Mohamed Ali Island sound rock was 4 metres deeper than shown on the drawings, but as some excavation had been done here during the previous season, it was possible to begin the masonry in April.

During the month of June every effort was made to put in as much masonry as possible. Masonry was carried on every day of the week, and at the Bab-el-Kebir it was continued at night by means of electric light. The average daily number of masons employed during the month was 353, and 45,000 cubic metres of masonry was laid during the 30 days. During July it was possible to stop night work, and before the middle of the month, judging from the readings of the Nile gauges received from stations further south on the river, it was seen that everything could be finished in time. On the 12th July the

“sadd” in the central channel was cut to relieve the head on the sadds in the other channels. This was followed by the cutting of the sadd in the Bab-el-Soghayar on the 19th July, and of the sadd in the Bab-el-Kebir on the 22nd July. The water now had a free passage through the sluices, but, as it did not reach the level of the top of the masonry, building was continued from the timber trestle alongside the dam until the first week of August; after that date the Nile quickly rose over the masonry and all work was suspended during the flood except a little masonry on the high ground at the east bank.

The work during the season was very much helped by the extremely low Nile the lowest of which there is any record. In an average year the Aswan gauge falls to R.L. 85.00 and remains below R.L. 86.00 from the 14th March to the 29th June; during the season under review it fell to R.L. 84.07 and remained below R.L. 86.00 from the 28th December to the 12th July.

After the flood, masonry was again started in the channels towards the end of November, and preparations were made for sadding the west channel, the only portion of the river in which the foundation masonry was not laid. The progress of excavation and masonry on the dam is shown in Plates 2 and 3.

During the year the excavation in the navigation channel was nearly completed and the masonry was begun in June.

7.—The quantities of permanent work executed to the end of the year for dam and locks combined are shown below.

KIND OF WORK.	Quantity executed		TOTAL.
	to end of 1899	during 1900.	
	C.M.	C.M.	C.M.
Excavation... ..	368,664	208,851	577,515
Masonry ... ..	74,863	164,605	239,468

Out of a total length of dam of 2,000 metres the foundation masonry is laid for 1,825 metres. Taking dam and navigation channel together, about 78 per cent of the excavation and 45 per cent of the masonry is complete.

8.—The Sub-Contractors for the ironwork, Messrs. Ransomes & Rapier, Limited, have done a considerable amount of work during the year. The cast-iron linings for 20 sluices have been erected, and the cast-iron grooves and cills for 45 sluices have been fixed.



9.—The value of Permanent Work executed in shown below.

To end of 1899.	During 1900.	Total to end of 1900.
£	£	£
340,281	597,339	937,620

10.—In accordance with the terms of the contract advances have been made to the Contractors and to the Sub-Contractors for iron-work on Preliminary Works, Materials and Plant to the amount of £547,477. An advance of £29,300 has also been made in connection with land required for the works.

The total payment to Contractors and Sub-Contractors to the end of the year is therefore as follows :—

	£	
A-swan Dam ... ..	730,685	
A-swan Navigation Channel ... ..	130,291	
Subsidiary Works ... ..	9,600	
Import Duties ... ..	35,368	
Ironwork... ..	31,676	
Total Permanent Work... ..	937,620	
Less retention ... ..	33,000	904,620
Advance on Preliminary Work ... ..	164,504	
.. Plant ... ..	75,670	
.. Materials ... ..	213,874	
.. Ironwork ... ..	93,429	547,477
Land... ..	29,300	
Total payment... ..	£1,481,397	

#### *Workmen.*

11.—The average number of men employed during the year was 5,134, of whom 987 were Europeans. The maximum number employed during the month of June was 9,308.

#### *Diagrams.*

12.—The following diagrams accompany this report, viz :—

Plate No. 1.—General Plan of Reservoir Works.

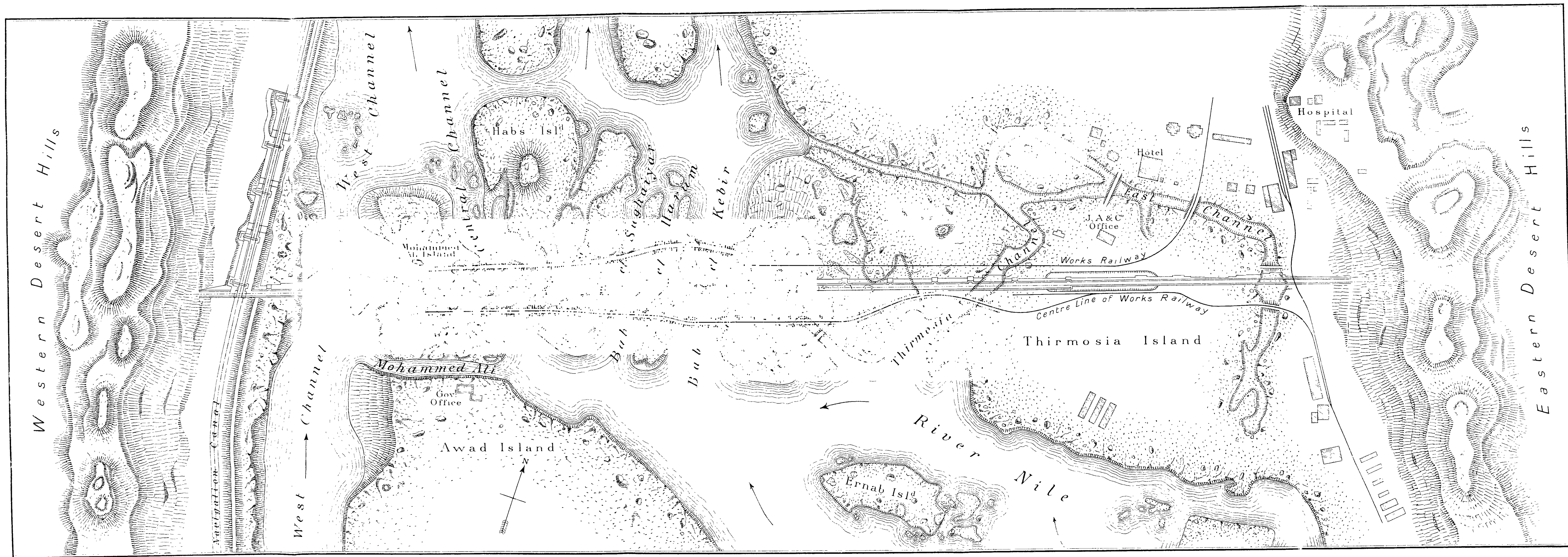
.. 2.—Longitudinal section of Dam showing yearly progress of excavation.

Plate No. 3.—Longitudinal section of Dam showing yearly progress of masonry.

Plate No. 4.—Cross-section of Dam.

NILE RESERVOIR WORKS ASSUAN-GENERAL PLAN.

PLATE I.



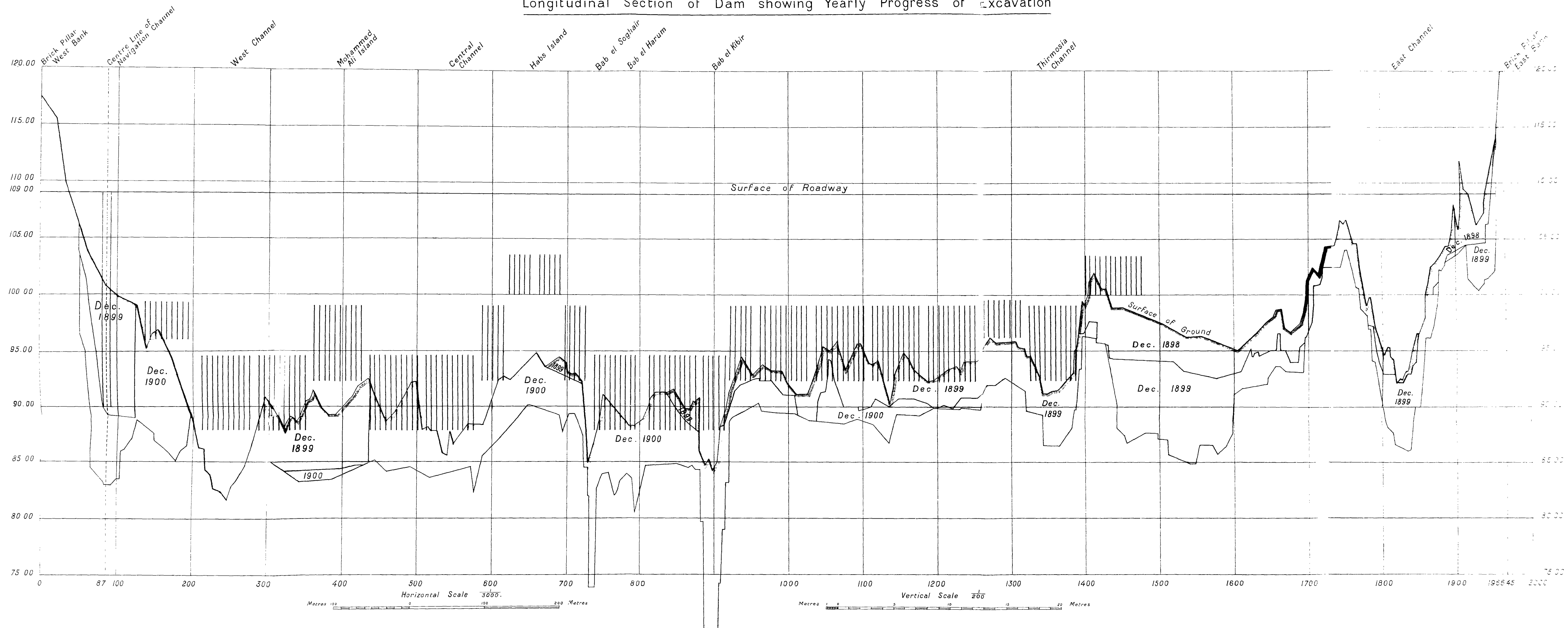
Scale 1:4000

Metres 100 50 0 100 200 300 Metres



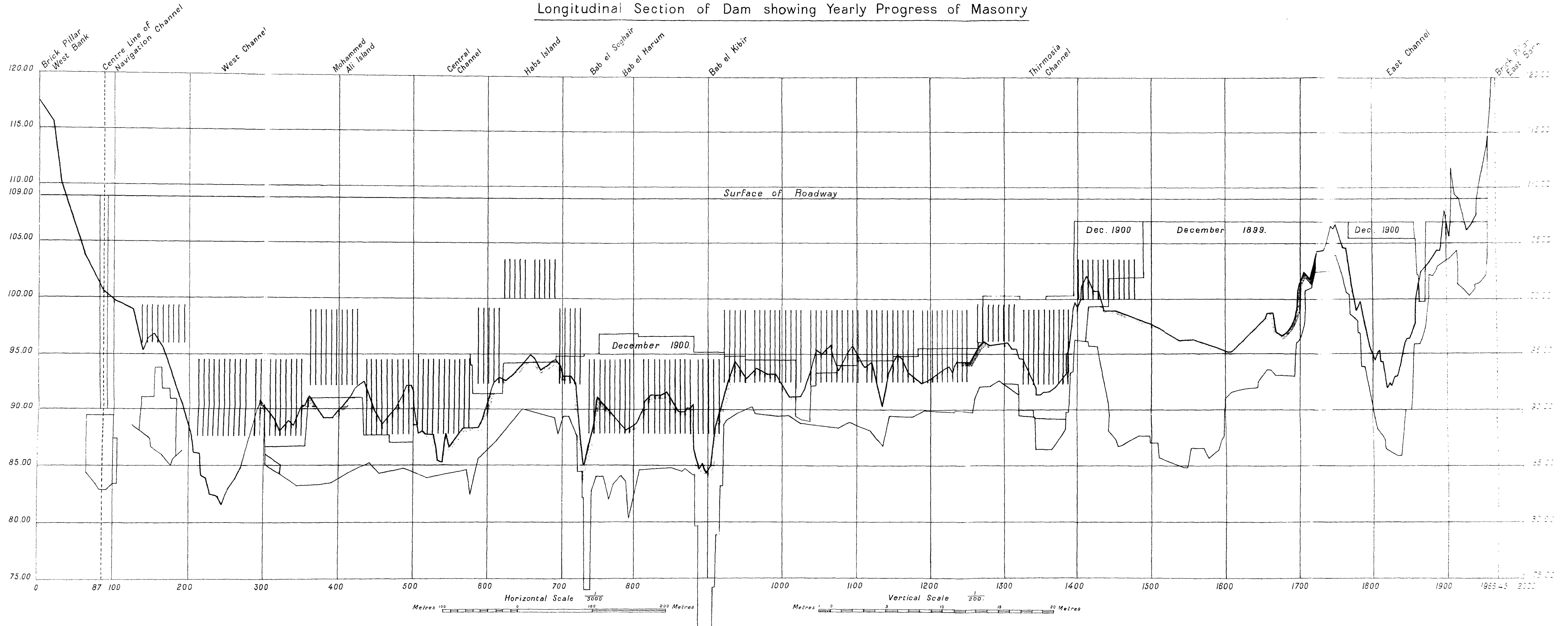
# NILE RESERVOIR WORKS ASSUAN

Longitudinal Section of Dam showing Yearly Progress of Excavation





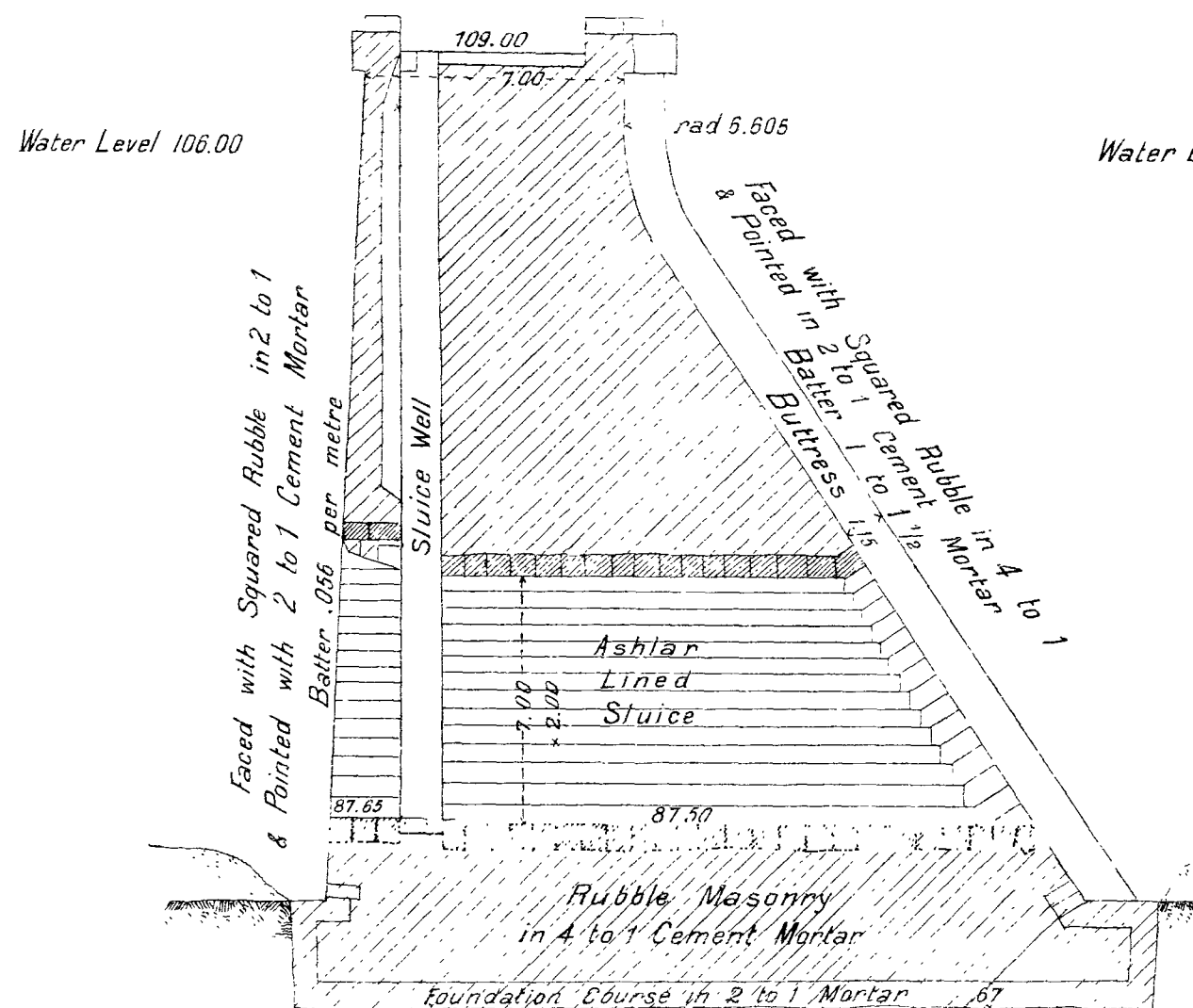
NILE RESERVOIR WORKS ASSUAN.  
Longitudinal Section of Dam showing Yearly Progress of Masonry



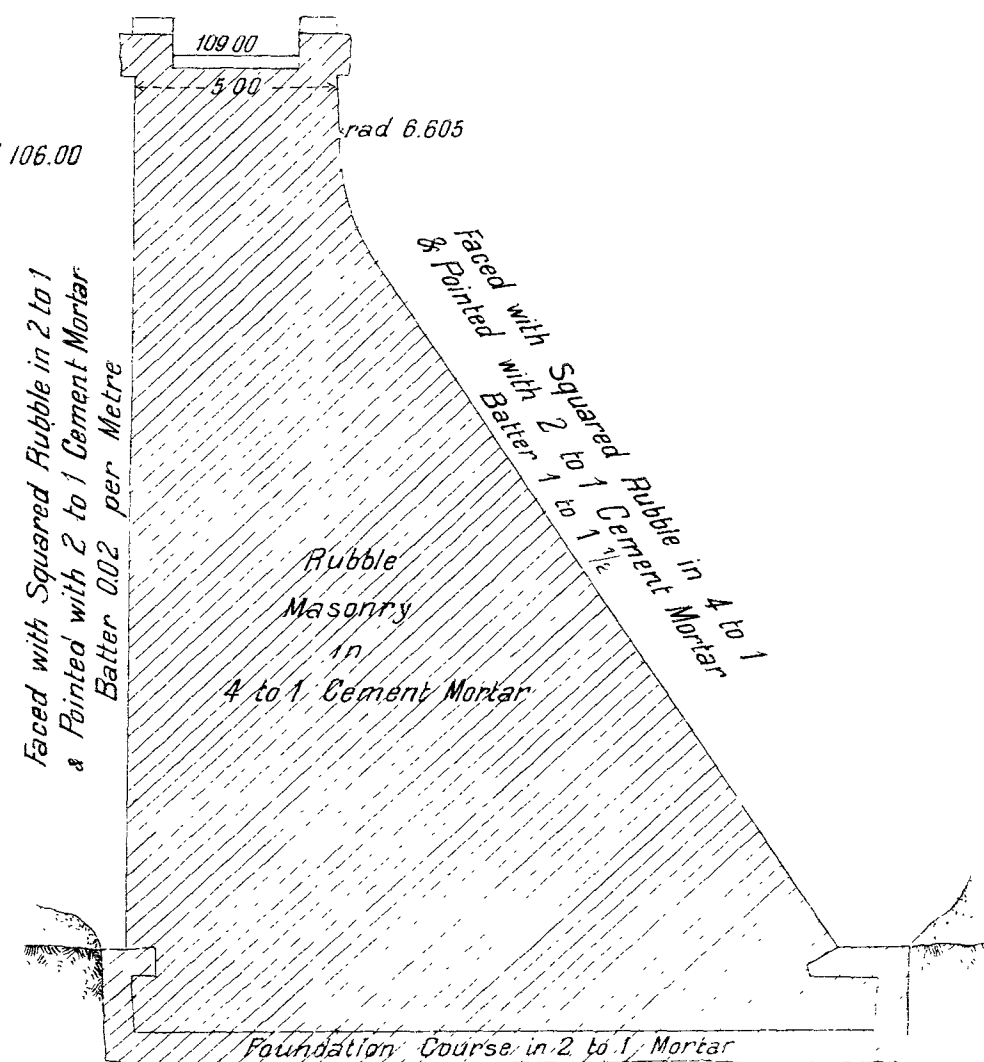


# NILE RESERVOIR WORKS, ASSUAN.

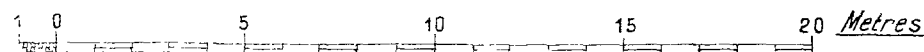
Section of Pierced Dam



Section of Solid Dam



Scale  $\frac{1}{200}$







The above work represents 26 % of the amount of the whole structure when completed.

The payments made by the Government to the Contractor for work done from the commencement up to December 31st, 1899, amounted to £E.331,809.

*Work during season 1900.*

16.—Owing to the very favourable conditions of the river after the very low flood of 1899 an early commencement was made with the preliminary works.

From soundings taken during and after the flood it was ascertained that changes had taken place in the bed of the river: the deep channel had moved near the east bank, making the conditions there less favourable for work than in the previous season, whilst the sand-bank on the west side had increased in width, closing up the narrow deep channel which existed near the bank during the previous season's work, and completely covering with silt the end of the previous year's work on the floor of the Barrage.

Sadd making was commenced on the west side on November 23rd, and on the east side on December 5th.

Masonry in continuation of the previous season's work was commenced on the lock wall on December 26th, and on the piers on January 10th. By January 10th, new sadds with the necessary pumps, enclosing a further length of 150 metres on the west side and 140 metres on the east side were completed.

Pile driving was commenced on the west side on January 23rd and on the east side on February 10th.

The concreting of the lower part of the floor was commenced on the west side on February 27th and on the east side on March 19th.

Work was continued under the highest pressure until July 23rd, when the rising flood unfortunately caused a breach in the sadds last made, thus stopping all further work. This accident occurred about five days before the date fixed for the termination of the season's work: all the pumps and machinery were recovered by the aid of divers, but some small loss of material had to be reported. The piles on the up and downstream sides of the floor had been driven right across the river before the accident occurred, but a length of 20 metres of floor remained wholly unbuilt, and a further length of 140 metres only partially built.

Bad springs were again encountered over practically the whole site of the foundations, but these were successfully dealt with, and the floor was in all places built to the full required thickness.

## ASYUT BARRAGE AND LOCK.

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### *Object and Description.*

13.—In order to make a fair distribution of the water of the Aswan Reservoir, a Barrage is being built across the Nile at Asyut, immediately to the North of the head of the Ibrahimiyah Canal. By the construction of this Barrage the supply of the canal will be augmented, so that the existing perennial area of Middle Egypt and the Fayoum will enjoy improved irrigation during the summer, and about 300,000 feddans of basin land will be converted to perennial irrigation.

The Barrage will be an open weir of 111 bays, each 5 metres wide; abutment piers 4 metres thick occur after every ninth opening, the intermediate piers being 2 metres thick; the piers are spanned by arches carrying a roadway 4·50 metres wide. Two regulating gates, one upper and one lower, each  $2\frac{1}{2}$  metres high, will be provided for each opening, and these, when in position, will be capable of holding up from 2·50 to 3·00 metres of water during the summer months. The length of the Barrage will be 833 metres, and the height from the floor surface to the road surface will be 12·50 metres.

On the western side a lock 80 metres long and 16 metres wide, large enough to pass any steamer on the Nile, will be provided.

### *Design and Construction.*

14.—As the bottom of the river at the site of the Barrage consists of sand, a foundation has to be artificially made upon which to build the superstructure. This foundation is composed of combined masonry and concrete floor extending from shore to shore, and laid throughout at the same level; its width is  $26\frac{1}{2}$  metres and thickness 3 metres. The upper surface of this floor approximately corresponds with the average level of the river bed.

Many alterations in the original design have been made, the principal ones being the following, viz.:—

(a) *Material*.—It was originally intended to build the floor of concrete and brickwork combined and the superstructure wholly of brickwork, but the clay obtainable near the site of the works was found unsuitable for the manufacture of bricks and it was decided to use Isawiyah stone instead of bricks.

During the season the sadds enclosed at different times the whole width of the river bed commencing from the end of the previous season's work. The navigation of the river was carried on through the deep channel on the east side until May 31st, when it was closed by the completion of the last sadds made from the west side which joined up with the cross sadd which enclosed the sadds made from the east side. The up and downstream sadds on the east side had been cut two days previously which enabled a new channel to be provided over the finished floor on the east side, two of the piers having been left unbuilt for the purposes of navigation. This channel remained the only navigable waterway until the end of July, when the rising flood allowed navigation through the lock and over the tops of several unfinished piers.

The chief items of work done during the season up to the end of July were as follows:

Sadds ... ..	233,100 cubic metres.
Sadds, sand-bags used on ...	1,462,000 No.
Excavation and filling ... ..	421,870 cubic metres.
Dredging... ..	92,000 "
Pumping... ..	Seventeen 12-inch pumps with several smaller ones were constantly at work throughout the busy part of the season.
Cast-iron piles ... ..	1,241 lineal metres.
Concrete and masonry in floor	46,126 cubic metres.
Masonry above floor level ...	26,320 " "
Pitching and clay puddle ...	52,183 " "

The above work represents 49%, or, together with the previous season's work, 75% of the amount of the whole structure when completed.

The lock, with the exception of fixing the gates and the swing bridge, is now practically completed. Twenty-seven piers are up to full height, 43 others are three-quarters their full height, and 19 others have been brought up above the summer water level, leaving only 21 piers yet unbuilt.

17.—The average daily number of workpeople engaged during the most important working months was as follows:—

MONTHS.	Europeans.	Natives.	Total.
January ... ..	327	8,087	8,414
February ... ..	317	7,843	8,160
March... ..	287	6,970	7,257
April ... ..	287	6,972	7,259
May ... ..	381	12,500	12,881
June ... ..	370	12,300	12,670
July ... ..	297	9,350	9,647

18.—The payments made by the Government to the Contractors for work done during the year ending December 31st, 1900, amounted to £E.237,361.

#### IBRAHIMIYAH CANAL REGULATOR AND LOCK.

19.—This work, which will be built at the head of the existing channel of the Ibrahimiyah Canal at Asyut, will consist of a regulator of 9 bays of 5 metres each, and a lock 50 metres long, by 9 metres wide. Its design is almost identical with that of the Asyut Barrage: its object is to regulate the supply entering the canal during high floods so as not to endanger the canal itself, or the different regulators and canals at Deirut. The work is designed to withstand a head of water of 4'00 metres.

No work was done during the season 1900, but at the end of the year 1900 the work on the canal diversion was being vigorously pushed.

20.—The following diagrams accompany this report, viz.:—

Plate No. 1.—Progress plan showing work done during seasons 1899 and 1900.

Plate No. 2.

Plate No. 3.

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#### ESTABLISHMENT.

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*At Aswan.*

21.—Mr. Fitzmaurice is the Resident Engineer of the Aswan Reservoir; his Chief Assistants are Mr. C. R. May and Mr. M. Macdonald. In addition to the above, fourteen other Engineers and Inspectors are employed on behalf of the Government. Mr. W. Duncan, Inspector, was unfortunately killed by an accident on the works in September.

Mr. John Blue is General Manager for the Contractors, Messrs. John Aird and Co. Mr. W. Bakwell is their principal Engineer, and he is assisted by Mr. McCorquodale and five other Engineers.

Mr. E. H. Tabor represents Messrs. Ransomes and Rapier, Limited, the Sub-contractors for ironwork.

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22.—Mr. G. H. Stephens is the Resident Engineer at Asyut, his Chief Assistant is Mr. Hood; in addition there are three other Engineers and five Inspectors.

Mr. McClure is the Contractor's Agent, and is assisted by Mr. W. McQueen and three other Engineers.

23.—Sir Benjamin Baker, Sir John Aird, Mr. John Aird and Mr. Basil Ellis all visited the works during the season.

24.—The Director General of Reservoirs was the late Mr. W. J. Wilson until the 13th August when his death deprived the Government of his exceptional abilities and experience of the works from their commencement, and the whole staff of a true and esteemed friend.

From the 13th August I was acting as Director General, and on the 1st December was confirmed in that post.

A. L. WEBB.



ASSIUT BARRAGE D S. VIEW LOOKING EAST.





(b) *Floor*.—In the original design the thickness of floor was 2 metres, and round wells 2 metres deeper were provided under the piers and abutments. The wells have been dispensed with entirely and a solid floor 3 metres thick throughout substituted for them.

(c) *Curtain walls*.—In the original design rectangular wells, respectively 5 and 4 metres below floor level, were provided up and downstream of the floor; instead of these wells cast-iron sheet piles have been employed with water-tight joints.

The length of the Barrage has also been slightly shortened. The design for the superstructure remains practically the same as originally intended.

The concrete and masonry of the floor are in cement mortar; in the walls and piers above floor level the mortar is of lime and homra.

### *Work during season 1899.*

15.—The work done during the season of 1899 was confined to the western side, and consisted in laying the floor forming the foundations of the lock, together with the floor under the site of 29 regulating gate openings (or about one-quarter of the length of the Barrage), and building the lock walls and piers up to a height just above the summer Nile level.

Sadd making was commenced on December 1st.

Pile driving was commenced on March 2nd.

Concreting in floor was commenced on May 4th.

Masonry in floor was commenced on May 7th.

Work was continued for a great part of the season by night as well as day until August 6th, and on August 7th, the sadds enclosing the site of the season's work were cut.

Bad springs were encountered over practically the whole site of the foundations, but grouting pipes were left in over all the important ones, and on the completion of the season's work all cavities formed by the springs were grouted up through these pipes.

The chief items of work done during this season up to August 6th inst. were:—

Sadds	... ..	96,228 cubic metres.
Sadds, sand-bags used	... ..	289,332 No.
Excavation & filling	... ..	359,432 cubic metres.
Pumping	.. .. .	Ten 12-inch pumps with several smaller ones were at work during the latter part of the season.
Cast-iron piles	... ..	693 lineal metres.
Concrete and masonry in floor	...	28,929 cubic metres.
Masonry above floor level	...	8,307     "     "
Pitching and clay puddle	...	30,147     "     "
Timber piling	... ..	12,120 cubic feet.

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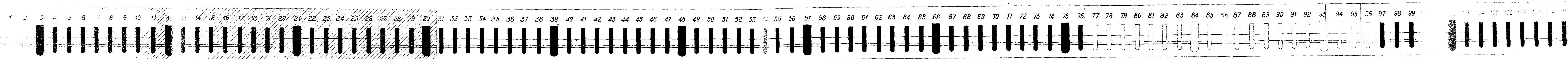
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From the 13th August I was acting as Director General, and on the 1st December was confirmed in that post.

A. L. WEBB.



110 OPENINGS, 5 METRES WIDE

PROGRESS PLAN SHOWING WORK DONE DURING SEASON 1899 AND 1900

SCALE  $\frac{1}{1000}$

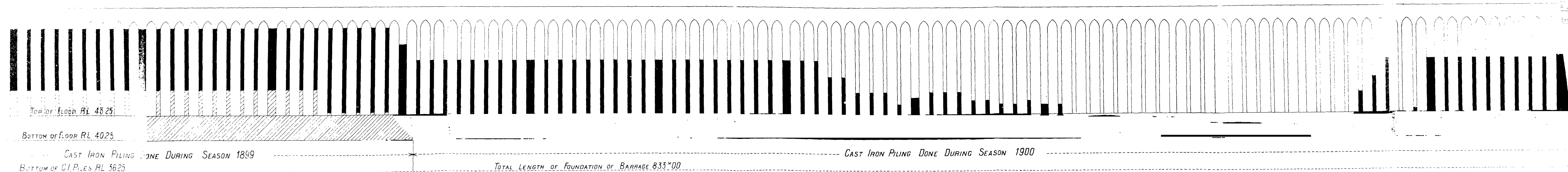
NOTE: SEASON 1899 HATCHED BLACK LINE

1900 COLOURED BLACK

WIDTH OF FLOOR BETWEEN PILES 26'-50

ORDINARY PIERS 2<sup>m</sup>.00 WIDE

ABUTMENT PIERS 4' 00" WIDE



## SCALES

$$\begin{aligned} \text{HORIZONTAL} &= \frac{1}{1000} \\ \text{VERTICAL} &= \frac{1}{250} \end{aligned}$$



The diagram shows a cross-section of a weir structure. The weir body is built with stone masonry and has a central vertical opening. The upstream side (left) is higher than the downstream side (right). Key features include:
 

- Water Levels:**
  - High Flood Upstream R.L. 53.95
  - Summer Level Upstream R.L. 47.00
  - High Flood Downstream R.L. 53.80
  - Lowest Water Level R.L. 44.50
- Dimensions:**
  - Upstream water depth at summer level: 20.00
  - Downstream water depth at lowest level: 20.00
  - Height of weir from lowest water level to top: 10.70
  - Width of weir crest: 4.00
  - Width of downstream slope: 10.00
  - Width of upstream slope: 5.50
  - Width of central opening: 1.00
- Structural Details:**
  - CLAY PUDDLE:** Located at the base of the upstream slope.
  - CONCRETE:** Foundation material under the weir body.
  - PEBBLES FINE SAND:** Material at the base of the downstream slope.
  - Layer of Broken Stone:** Indicated on the upstream slope.
- Other Labels:**
  - R.L. 56.85 (Top of upstream wall)
  - R.L. 57.25 (Top of downstream wall)
  - R.L. 53.95 (High Flood Upstream)
  - R.L. 53.80 (High Flood Downstream)
  - R.L. 44.50 (Lowest Water Level)
  - R.L. 47.00 (Summer Level Upstream)





## APPENDIX.

STATEMENT SHOWING THE EXPENDITURE ON RESERVOIR WORKS TO END OF 1900.

	EXPENDITURE IN			
	1898	1899	1900	TOTAL.
	£	£	£	£
Permanent Work, Aswan Dam ... ..	20,886	273,075	567,015	860,976
Retention under Clause 39 of Specification.	3,132	29,264	604	33,000
Payment on account of Permanent Work.	17,754	243,811	566,411	827,976
Advanced on Preliminary Works, Aswan Dam... ..	20,729	72,746	71,029	164,504
Advanced on Plant ... ..	31,040	53,545	—8,915	75,670
„ Materials ... ..	25,376	142,813	45,685	213,874
„ to Messrs. Ransomes & Rapier.	—	55,972	69,133	125,105
Total payment on account of Aswan Dam.	94,899	568,887	743,343	1,407,129
Advanced on account of Asyut Weir & Lock	46,024	274,917	240,765	561,706
„ „ payment for Land.	23,400	12,100	500	40,000
„ „ Import Duties ...	8,100	18,900	13,000	40,000
Subsidiary Works ... ..	3,934	8,731	—1,315	11,350
Total... .. £	176,357	883,535	1,000,293	2,060,185



# REPORT ON THE TANZIM DEPARTMENT

1900

BY

A. H. PERRY.



## REPORT ON THE TANZIM DEPARTMENT, 1900.

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UNDER SECRETARY OF STATE,  
PUBLIC WORKS DEPARTMENT.

I have the honour to submit a report on the operations of the Tanzim Department in 1900.

The following Services are treated separately:—

- 1 Special Works, Lower Egypt.
- 2 Special Works and Inspection, Upper Egypt.
- 3 Inspection North.
- 4 Architects Department.
- 5 Roads.
- 6 Gardens.
- 7 Tramway.
- 8 Scavenging and Watering.
- 9 Gas.
- 10 Electric Lighting.
- 11 Helwan Water-works.
- 12 Gizeh and Gesireh Water-works.
- 13 Bridges.

I would draw special attention to the good work done by:—

Mr. Sayed Bey Choucri.	Mr. Reboul.
„ Hewat.	„ Powell.
„ Clifton.	„ Curtis.
„ Chapman.	„ Fitz Patrick.
„ Pastour.	

Habib Effendy, Chief Accountant, has as usual kept his service in admirable order.

A. H. PERRY.

*Director General, Towns and Buildings.*

Cairo, 17th April 1901.

# ACCOUNTS.—TANZIM OPERATIONS IN TERMS OF CREDITS, 1894-1895 AND 1899-1900

YEAR.	CAISSE.						Combined Tanzim Ordinary Budgets.	Totals of Nos. 5 and 7.	Totals of Nos. 5, 6, and 7.	Special Depart- ments.	Gizeli, Ghozeli, and Helouan.	Grand Total.	Increase on 1891.
	Balance, previous year.	New Credits.	Total.	Sums spent on works completed.	Balance brought down.								
1	2	3	4	5	6	7	8	9	10	11	12		%
	£R.	£R.	£R.	£R.	£R.	£R.	£R.	£R.	£R.	£R.	£R.	£R.	%
1894	—	—	—	—	—	145127	145127	145127	8846	—	153973	153973	—
1895	—	306040	306040	21697	284343	110928	162625	446968	47966	—	494934	494934	—
1899	284831	62000	346831	152496	194335	195178	347671	512009	55314	11200	554682	554682	—
1900	194335	120783	315118	142333	172785	219741	362074	534859	12154	7669	608753	608753	—

Increase of work as H to 4.

BUILDING.	CAIRO.			COMPARISON WITH EUROPEAN PRICES. COST OF AN EQUAL CUBE. £R.						
	M <sup>3</sup> in building.	Cost per M <sup>3</sup> £R. m/m	Cost of building £R. m/m Nod.	ITALY.		ENGLAND.				
				Mansions.		Mansions.		Public Libraries.	Foreign Office.	Manchester Assize Courts.
				1st. Class.	2nd Class.	1st. Class.	2nd Class.			
				£R. 104 m <sup>3</sup>	£R. 687 m <sup>3</sup>	18. 1d. ch. ft.	3d. ch. ft.	3d. ch. ft.	18. 0 <sup>1</sup> d. ch. ft.	3 <sup>1</sup> d. ch. ft.
Egyptian Museum...	259400	0766	*198713	263032	232082	£R. 1865 m <sup>3</sup>	£R. 1291 m <sup>3</sup>	£R. 1291 m <sup>3</sup>	£R. 1829 m	£R. 1363m <sup>3</sup>
Native Law Court...	109000	0713	77707	110526	97773	£R. 1865 m <sup>3</sup>	£R. 1291 m <sup>3</sup>	£R. 1291 m <sup>3</sup>	£R. 1829 m	£R. 1363m <sup>3</sup>

\* Add { £E.3610 were spent on medals and competition drawings. } Total £E.20210.  
 " 8102 " indemnity to English War Office.  
 " 8499 will be spent on transport of antiquities.

PERMANENT STAFF FIGURING ON OUR BUDGET  
BUT OCCUPIED ELSEWHERE.

The total Credit of £E.21,568 allowed by the Budget for the Permanent Staff has been fully expended.

The following Engineers are paid from this Budget but are apart from this Service.

										£E.
One	Engineer,	Daira Khassa	...	...	...	...	...	...	...	240
1st	"	Ras-el-Tin Palace	...	...	...	...	...	...	...	300
2nd	"	" "	...	...	...	...	...	...	...	84
One	"	Governorat Cairo	...	...	...	...	...	...	...	180
1st	"	Mehemet Charieh	...	...	...	...	...	...	...	108
2nd	"	" "	...	...	...	...	...	...	...	96
										<hr/>
Total ... ..										£E.1,008





PARALLÈLE DES CRÉDITS POUR TRAVAUX NEUFS, ENTRETIEN ET RÉPARATIONS, PENDANT LES DOUZE DERNIÈRES ANNÉES 1890 A 1901.

Désignation.	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
Abattoirs publics ... ..	—	600	1800	1000	500	5000	5000	5000	5000	5000	5000	5000
Services Sanitaires ... ..	4000	7200	6000	14000	12000	12000	12000	12000	12000	12000	12000	3000
Prisons ... ..	4000	—	—	2200	—	4800	5000	5000	5000	5000	—	—
Écoles ... ..	750	—	2100	2000	2100	—	—	—	9000	9000	—	—
Tribunaux ... ..	1200	2000	4500	3000	3340	4100	4000	1830	1000	—	—	—
Markaz de Police ... ..	3500	6800	5000	1300	4000	1500	—	—	—	—	—	—
Moudirichs et Gouvernorats ... ..	1040	—	600	—	3500	2500	—	—	—	—	—	—
Douanes, Postes, Choumahs, Ports et Phares, Quais ... ..	2100	2600	4300	4400	5997	1890	5385	5600	1300	—	—	—
Divers ... ..	—	5650	2160	—	—	—	—	2000	—	—	—	—
Retenue de garantie ... ..	750	—	—	1328	1300	1300	3000	3000	3000	3000	12000 13705	12000
Réserve ... ..	5510	6600	5000	5200	3020	5570	13275	13275	11405	13705		
Total crédit travaux neufs...	21350	31450	31460	37428	35757	11660	17660	17705	17705	47705	29000	20000
Entretien et réparations...	15236	14000	14000	14000	14000	14000	15260	16260	16260	16560	31925	43925

FLUCTUATIONS IN VALUE—IRON, STEEL AND COAL.

	January 1896	%	January 1897	%	January 1898	%	January 1899	%	January 1900	%	January 1901	Partial fall or rise.	Total rise on 1896.
Steam coal, F. O. B. Cardiff ...	0·10·6	—	0·10·6	—	0·11·0	+ 4·8	0·13·8	+ 18	0·19·0	+ 46	1· 0·0	+ 5	90
„ „ Newcastle ...	0· 8·0	—	0· 8·8	—	0· 8·3	+ 3·1	0· 9·9	+ 18	0·14·6	+ 48·8	0·13·6	— 8	69
Pig Iron, Glasgow No. 3 ...	2· 6·0	—	2· 8·9	+ 6	2· 5·0	— 8	2· 9·6	+ 10	3· 5·0	+ 31·3	3· 1·6	— 5·7	33·7
„ „ Middlesboro No. 3 ...	1·18·0	—	2· 0·9	+ 5	2· 1·0	—	2· 4·6	+ 8·5	3· 5·0	+ 4·6	2·11·6	— 2·6	36
Iron ship plates, Middlesboro ...	4·17·6	—	5·10·0	+ 12·8	5· 2·6	— 7·3	6·10·0	+ 26·8	7·15·0	+ 19	6·12·0	— 17·5	35
Iron bridge plates ...	5· 0·0	—	5·12·6	+ 12·5	5·17·6	+ 4·4	6·15·0	+ 14·9	8· 0·0	+ 19	6·15·0	— 18·5	35
Steel ship and bridge plates ...	5· 0·0	—	5·15·0	+ 15	5·15·0	—	7· 0·0	+ 21·8	8· 0·0	+ 14	6·15·0	— 18·5	35
Heavy steel rails, F. O. B. ...	4·12·6	—	4·12·6	—	4·12·6	—	4·12·6	—	7· 0·0	+ 51	6· 0·6	— 18·6	30

## I.—SPECIAL WORKS, LOWER EGYPT.

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*Vide Chief Architect's Original.*

The building now in course of construction is situated on the north-west of Cairo, close to the Nile bank.

The choice of site was influenced by the fact that its proximity to the Nile admits of easy transport by river of the contents of the present Museum at Ghizeh; it is, further, within a short distance of the European Quarter.

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A large number of plans were in due course submitted to the jury, who, having selected four as fulfilling the necessary requirements, divided the prize equally among the designers.

M. Dourgnon, one of the competitors, was finally entrusted with the task of submitting a complete design.

As executed, the latter differs very considerably from the one which he presented and which received a prize from the jury.

The new Museum in plan resembles an inverted T. The longitudinal axes of the head and stem consist respectively of a vast transept and nave round which are grouped the exhibition chambers. A wide gallery runs round the building and communicates at the two ends of the head of the T with the main staircases.

The disposition of the first and ground floors is identical.

Small galleries surround the main Atrium (nave). The latter is roofed with a vast skylight. The pavement of the ground floor under the skylight is deeply recessed, thus somewhat incongruously suggesting an impluvium.

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As in the Roman style, a marble archivolt springs from the impost formed by an architrave resting on the capitals of marble columns.

The tympanum is of the claustra type. The portal as a whole is slightly recessed behind the line of the central section, thus forming two buttresses. These carry, at an elevation of 13 metres, two female figures in high relief, representing respectively Upper and Lower, or Pharaonic and Modern Egypt.

Between the central and lateral projecting buttresses run porticoes.

The east and west sections will respectively contain sale rooms and a library.

On the first floor closed galleries replaced the porticoes.

The lateral facades are treated with extreme, not to say unsightly simplicity.

This may be explained by the fact that any constructive addition to the Museum must be made on the two flanks. Handsome facades may therefore still be added at some future time.

A dwelling house for the Director General is being built in the museum grounds, and quarters for the staff, stores, and workshops, have yet to be added.

From information furnished by M. Maspero, it appears that the objects composing the Ghizeh collection do not from their nature admit of a strictly chronological arrangement.

The order of dynastic classification will be approximately as follows:—

*Ground Floor.*—In the first three or four rooms nearest the main entrance and on the left of the central nave will be placed monuments belonging to the Empire of Thine and Memphis.

The three rooms next in order will be devoted to exhibits from the Theban Empire, while the end chambers to right and left will represent the period from the XVIII to the XXI dynasties.

Græco-Roman monuments in the Egyptian style and dating from the Empire of Sais, will occupy the right side of the ground floor.

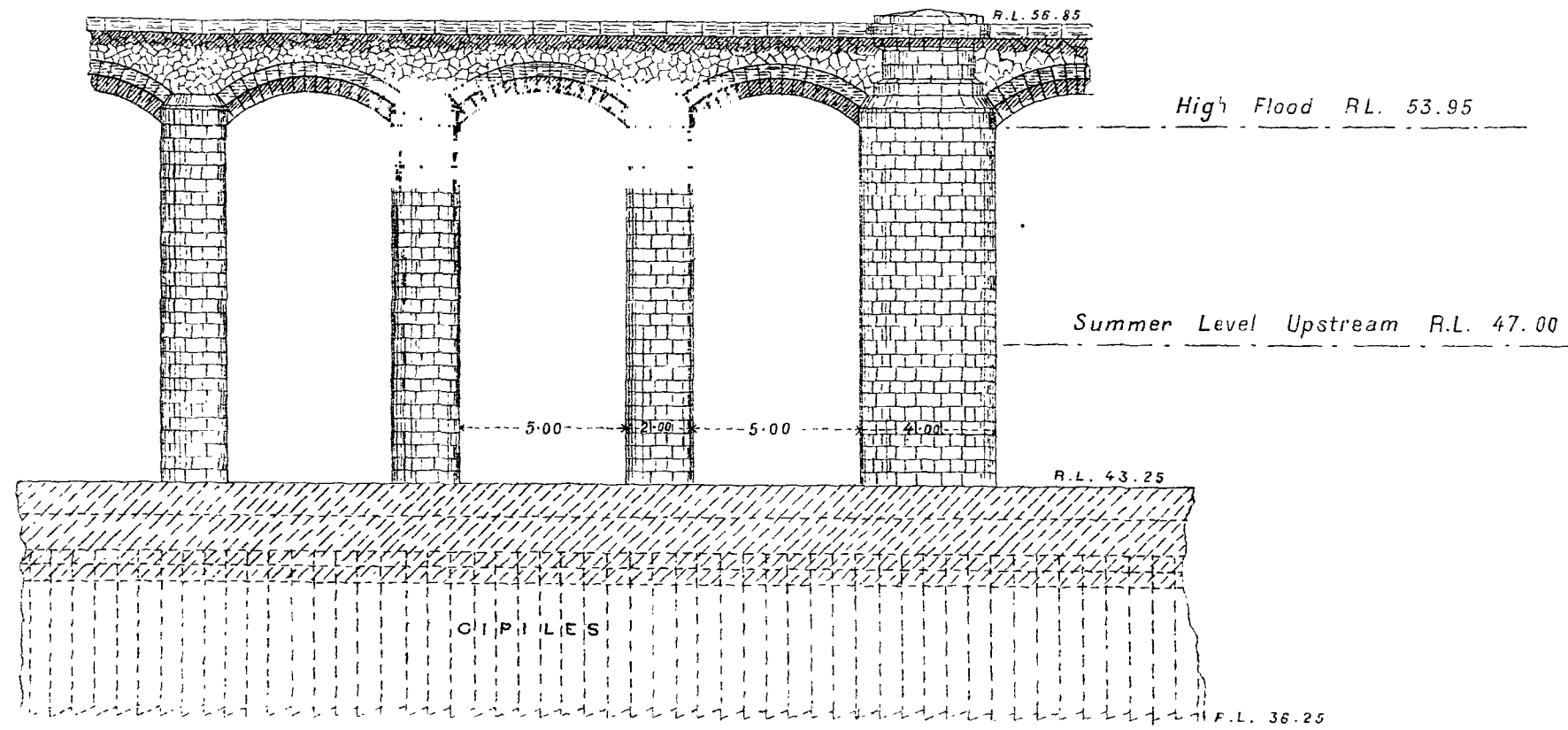
The royal mummies will be deposited in Mariettes' Hall which constitutes a species of apse.

On the right and left of this hall will be found Coptic and Græco-Roman monuments in the Greek style.

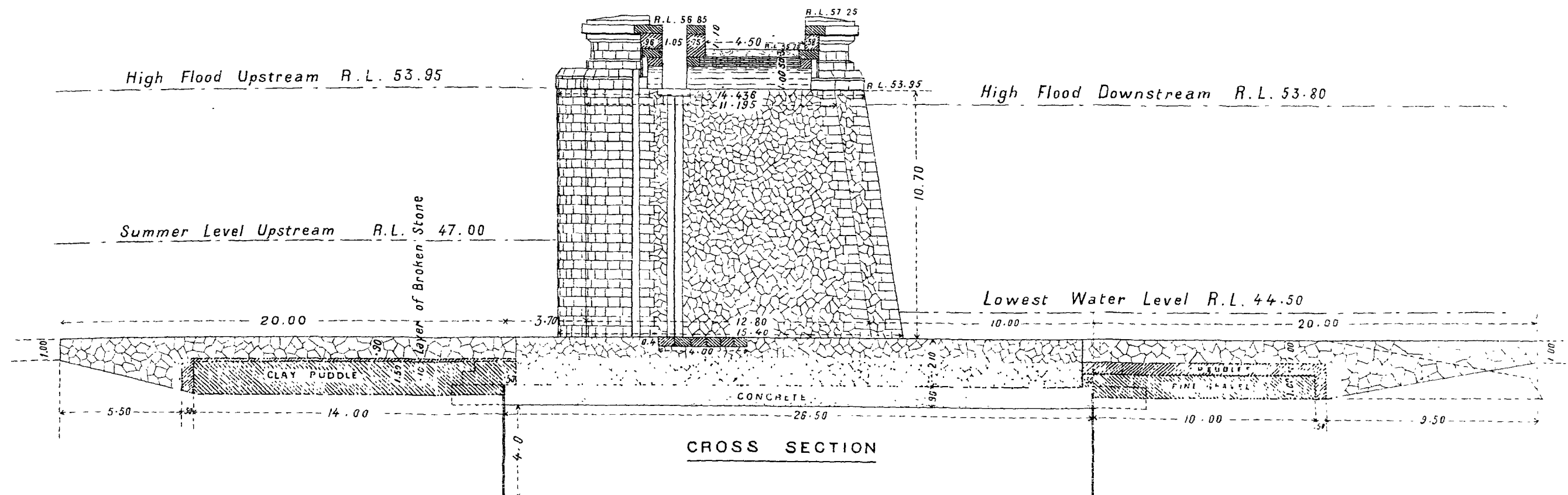
It will be M. Maspero's endeavour to group the monuments in such a manner as will leave on the mind of the visitor a clear idea of the development of art and of the state of civilisation existing at the period represented by each exhibition chamber. With this idea in view the impression produced by the heavy monuments, which must necessarily be placed on the ground floor, will be strengthened and completed by the display of selected smaller objects such as furniture, amulets, toilet

# ASYÛT BARRAGE

Scale =  $\frac{1}{200}$



UPSTREAM ELEVATION



CROSS SECTION



# APPENDIX.

STATEMENT SHOWING THE EXPENDITURE ON RESERVOIR WORKS TO END OF 1900.

	EXPENDITURE IN			
	1898	1899	1900	TOTAL.
	£	£	£	£
Permanent Work, Aswan Dam ... ..	20,886	273,075	567,015	860,976
Retention under Clause 39 of Specification.	3,132	29,264	604	33,000
Payment on account of Permanent Work.	17,754	243,811	566,411	827,976
Advanced on Preliminary Works, Aswan Dam... ..	20,729	72,746	71,029	164,504
Advanced on Plant ... ..	31,040	53,545	—8,915	75,670
„ Materials ... ..	25,376	142,813	45,685	213,874
„ to Messrs. Ransomes & Rapier.	—	55,972	69,133	125,105
Total payment on account of Aswan Dam.	94,899	568,887	743,343	1,407,129
Advanced on account of Asyut Weir & Lock	46,024	274,917	240,765	561,706
„ „ payment for Land.	23,400	12,100	500	40,000
„ „ Import Duties ...	8,100	18,900	13,000	40,000
Subsidiary Works ... ..	3,934	8,731	—1,315	11,350
Total... .. £	176,357	883,535	1,000,293	2,060,185





# REPORT ON THE TANZIM DEPARTMENT

1900

BY

A. H. PERRY.



## REPORT ON THE TANZIM DEPARTMENT, 1900.

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UNDER SECRETARY OF STATE,  
PUBLIC WORKS DEPARTMENT.

I have the honour to submit a report on the operations of the Tanzim Department in 1900.

The following Services are treated separately:—

- 1 Special Works, Lower Egypt.
- 2 Special Works and Inspection, Upper Egypt.
- 3 Inspection North.
- 4 Architects Department.
- 5 Roads.
- 6 Gardens.
- 7 Tramway.
- 8 Scavenging and Watering.
- 9 Gas.
- 10 Electric Lighting.
- 11 Helwan Water-works.
- 12 Gizeh and Gesireh Water-works.
- 13 Bridges.

I would draw special attention to the good work done by:—

Mr. Sayed Bey Choucri.	Mr. Reboul.
„ Hewat.	„ Powell.
„ Clifton.	„ Curtis.
„ Chapman.	„ Fitz Patrick.
„ Pastour.	

Habib Effendy, Chief Accountant, has as usual kept his service in admirable order.

A. H. PERRY.  
*Director General, Towns and Buildings.*

Cairo, 17th April 1901.



PERMANENT STAFF FIGURING ON OUR BUDGET  
BUT OCCUPIED ELSEWHERE.

The total Credit of £E.21,568 allowed by the Budget for the Permanent Staff has been fully expended.

The following Engineers are paid from this Budget but are apart from this Service.

									£E.
One Engineer,	Daira Khassa	...	...	...	...	...	...	...	240
1st       ,,	Ras-el-Tin Palace	...	...	...	...	...	...	...	300
2nd       ,,	" "	...	...	...	...	...	...	...	84
One       ,,	Governorat Cairo	...	...	...	...	...	...	...	180
1st       ,,	Mehemet Charieh	...	...	...	...	...	...	...	108
2nd       ,,	" "	...	...	...	...	...	...	...	96
									<hr/>
					Total	...	...	...	£E.1,008



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Prisons ... ..	4600	—	—	2200	—	4800	5000	5000	5000	5000	—	—
Écoles ... ..	750	—	2100	2000	2100	—	—	—	9000	9000	—	—
Tribunaux ... ..	1200	2000	4500	3000	3340	4100	4000	1830	1000	—	—	—
Markaz de Police ... ..	3500	6800	5000	4300	4000	1500	—	—	—	—	—	—
Moudirichs et Gouvernorats ... ..	1040	—	600	—	3500	2500	—	—	—	—	—	—
Douanes, Postes, Choumahs, Ports et Phares, Quais ... ..	2100	2600	4300	4400	5997	4800	5385	5600	1300	—	—	—
Divers ... ..	—	5650	2160	—	—	—	—	2000	—	—	—	—
Retenue de garantie ... ..	750	—	—	1328	1300	1300	3000	3000	3000	3000	12000	12000
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Steel ship and bridge plates ...	5· 0·0	—	5·15·0	+ 15	5·15·0	—	7· 0·0	+ 21·8	8· 0·0	+ 14	6·15·0	— 18·5	35
Heavy steel rails, F. O. B. ...	4·12·6	—	4·12·6	—	4·12·6	—	4·12·6	—	7· 0·0	+ 51	6· 0·6	— 18·6	30

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necessaries, etc., etc. The lateral galleries will contain the overflow from each chamber opening into them.

In the main galleries on the left of the entrance will be placed heavy sarcophagi of the Ancient Empire, and on the right those of the Sais dynasty.

The recessed portion of the central nave will contain colossi mounted on suitable pedestals; the north and south staircases will serve a similar purpose.

On the first floor and in the main facade rooms, will be exhibited jewellery and gold and silver articles.

The exhibits in the lateral chambers will consist of objects appertaining to civil life or representing art and trade, such as glass, pottery, tissues, mummies, cerements, papyri and articles relating to the teaching of sculpture or painting.

Zoological, anthropological and botanical collections will find room in the lateral galleries or south chambers.

It should be understood that the above is only an indication of the method of classification to be followed.

Local conditions will of course mainly influence the final dispositions.

## EGYPTIAN MUSEUM.

	Sq. Metres.
The area of ground enclosed is ... ..	30,625
.. of the building is ... ..	12,000
.. „ entrance hall (Galerie d'honneur) ... ..	1,620
.. „ Nave ... ..	630
.. „ Transept (Galerie postérieure) .. ..	700
.. „ other 4 corridors... ..	1,880
.. „ 18 rooms on the ground floor... ..	3,420
.. „ Roof ... ..	10,617
.. „ Skylights ... ..	3,000
.. „ Mosaic (1st Floor) ... ..	6,800
.. „ outside and inside plastering heights of building... ..	76,200
	Metres.
From ground floor to lower roof ... ..	14.30
.. „ „ „ upper roof ... ..	20.50
.. „ „ „ dome ... ..	32.40
.. bottom of Nave to upper roof... ..	22.65
.. „ „ „ „ dome ... ..	34.55

## ARAB MUSEUM.

The first story of this building is finished and the floor in beton armé of the second story is almost complete.

The total area of the concrete floor is 4,880 square metres.

The ground floor of this edifice will form the Arab Museum in which will be exhibited:—

Sculptured stones and marbles, enamelled glass, lamps, stiles, carved wood, embossed leather, earthenware pots, carved ivory, bronze, mosque lamps, musharabia, etc., etc.

	Sq. Met.
It contains an Entrance Hall of ... ..	83
Galleries... ..	355
Exhibition rooms ... ..	1,620
Stair-cases and offices ... ..	184

The first floor will contain the Khedivial Library. This floor comprises:—

	Area, Sq. Met.
1 room for drawings and maps ... ..	300
2 libraries ... ..	500
1 large reading room ... ..	366

and a room for the distribution of books and offices for the staff.

The amount spent in 1900 equals £E.14,259 and the total to date £E.34,380.

## LADY CROMER'S MEMORIAL.

This is a home erected by public subscription in memory of the late Lady Cromer, and is designed for the accommodation of from 50 to 60 foundlings.

It consists of a three-storied building. The ground floor contains at one end baths, and at the other the reception rooms. The two other floors contain two large and two small dormitories, a large recreation room, with a room for the attendant and a kitchen.

The building forms an annexe to the Kasr-el-Ainy Hospital. It should be finished in February, 1901 and will cost £E.3,670.

## NATIVE COURT OF APPEAL.

This important public edifice is now entirely completed and would bear eloquent testimony to the progress of the country were it not entirely hidden by the tumble-down mud-built constructions of one of

the most unsightly quarters of Cairo. A project presented by the Public Works Department for the expropriation and demolition of the surrounding tenements, and for carrying out the works necessary to endow this handsome structure with an environment in harmony with its importance, was postponed for want of funds.

The building will provide accommodation for the following Administrations:—

Court of Appeal.

Cairo Court of First Instances.

The internal disposition is as follows:—

Ground floor	}	Large Board room.
		8 Audience Chambers with the necessary deliberation and judges' offices.
First floor	}	Hall for Law Court Students.
		President and Vice-Presidents' rooms and various offices.

The ground area is 6,900 square metres and the total cost £E.102,288.

## PRISONS.

The designs for prisons are furnished by Mr. Favarger; the plans and calculations are corrected and checked and the documents for adjudication prepared in our Drawing Office.

The work is carried out under the supervision of the Tanzim Inspector of Special Works, who is alone responsible for its satisfactory execution. The type introduced by Coles Pasha consists of an oblong building 75 metres long  $\times$  19 metres broad. A corridor runs longitudinally from end to end, rising without interruption to the roof, which is here replaced by an open iron grating of the same area as the plan of the corridor.

This corridor is flanked on each side by three tiers of cells of the following dimensions:—

Ground floor, single...	...	...	...	...	...	...	...	...	...	3'00 $\times$ 2'00
First floor, single	...	...	...	...	...	...	...	...	...	3'00 $\times$ 2'00
Second floor, double...	...	...	...	...	...	...	...	...	...	8'55 $\times$ 3'08
Third floor, double	...	...	...	...	...	...	...	...	...	8'68 $\times$ 3'15

All corridors and cells are asphalted and the latter have grated apertures 0'75  $\times$  0'60.

The staircases are of iron with wooden treads.

An Infirmary is attached to the prison containing 18 beds and further a dwelling house for the European Governor.

The cost of the Cairo (Manshia) type, consisting of two blocks containing 384 prisoners each and comprising infirmary, latrines, exercise yard, is approximately £E.24,000.

#### DAR-EL-ULUM SCHOOL.

The object of this school is the education of scholars selected from the El-Azhar University who desire to follow the career of professors of the Arabic language, Arithmetic, Geography or elementary Mathematics. It has a semi-religious character. The college was founded in 1872, and a site was chosen at Darb-el-Gamamiz in the same building with the Polytechnic and the Khedivieh Schools.

It was transferred subsequently to Darb-El-Gineina where the “Prisons Mixtes” now stand.

It again reverted to its original position and remained there until the present building was completed. According to the Decree the School should contain 100 pupils, but owing to want of space the number never exceeded 60.

The new School is now built on a plot of land containing nearly 5,739 sq. met., opposite Kasr-El-Ainy Hospital.

The area of the building itself is 1,037 sq. met. Large verandahs of 516 sq. met., surround the School.

The play-grounds cover a surface of 4,186 sq. met.

The School contains a “Messalla” or Prayer Hall, Laboratory, Library Refectory, Reading-room and Class-rooms.

The School curriculum comprises:—

Arabic language ...	{ Dictation.
	{ Composition.
Mathematics... ..	{ Arithmetic.
	{ Elementary Practical Geometry.
Geography, Map-Drawing, History.	
Lessons in Morals.	
Object Lessons.	
Arabic Penmanship.	
Drawing.	
European Languages.	
Calligraphy.	

The construction is complete and has cost £E.7,500.

### MUBTADAIAN-SCHOOL.

The original School was founded in 1252 of the Hegira at Nasrieh in the south-east Quarter of Cairo, was then transferred to Abu-Zaabal, 20 kilometres down the Ismailieh canal, and again at Abbassieh.

In 1284 it returned to Nasrieh, where it stands to-day.

Before 1284 the pupils numbering 1,000 were all in-boarders.

After removal to Nasrieh, out-boarders were taken to the number of 300, while the number of in-boarders, owing to the lack of room, fell to 100. Government then decided to construct the new School at Kasr-El-Ali, in the south-west Quarter of Cairo.

The School is a primary school for pupils from 8 to 16 years old. The curriculum comprises:—

Teaching of the Koran.	English or French.
Islam.	English Penmanship.
Arabic Language.	Object Lessons.
Translation.	Geography.
Arabic Penmanship.	History.
Arithmetic.	Drawing.
Geometry.	

The School can contain 50 in-boarders and 350 out-boarders.

	Sq. Metres.
The ground area is ... ..	26,631
The area built over ... ..	3,091
The verandahs cover... ..	464
Play-ground ... ..	23,076

The School comprises:—

Three parallel ranges of buildings.

The first contains: Library, Drawing Office, Professors' Room and Class-rooms.

The second contains: Class-rooms, Refectory, "Massalla" (Prayer Room), Masters' Rooms.

The third: Large Refectory, Infirmary, Kitchens, Lavatory, Bath-Rooms and Dormitories.

This School will be finished in January, 1901, and will cost £E.22,500.

The latrines are outside in the Court.



DIRECTION, SPECIAL BUILDINGS, DELTA.

A.—WORKS TAKEN OVER FINALLY.

NAME OF WORK.	Sanction.	EXPENDITURE.		Date of final reception.	NAME OF CONTRACTOR.
		1900.	To date.		
Foundations, Primary School, Cairo ... ..	2024	282	2032	6-2-00	B. Antoniou.
Parcel Post, Alexandria, Gaz Installation... ..	100	10	100	21-3-00	Levi-Cuzzor & Cie.
Quarantine Station ... ..	41580	6878	41606	9-4-00	Guetin & Charvau.
Annexe Public Debt ... ..	2178	408	2145	14-5-00	N. Marciano.
Foundation, Normal School, Cairo ... ..	940	81	905	9-6-00	B. Antoniou.
Mehalla-el-Kobra Tribunal ... ..	2382	126	2204	22-6-00	Aly Badawi.
Demolition for Post Office, Cairo ... ..	300	250	250	3-10-00	J. Fumaroli.
Ismailia Custom House... ..	780	71	753	7-10-00	Guetin & Charvau.
First-floor Coast Guard Stables, Port-Said ... ..	1275	122	1214	8-10-00	do.
Chibin-el-Kom Hospital... ..	5507	378	5080	—	V. Vignao (guarantee not yet paid).
Galioub Slaughter House ... ..	570	3	537	24-12-00	Garozzo & Pucelle
Port-Said Slaughter House ... ..	2687	185	2492	—	Zaro & Patonna
Markaz Tonkh... ..	1900	80	1676	—	B. Chenouda
	63123	8877	61954		

# DIRECTION, SPECIAL BUILDINGS, DELTA.

## B.—WORKS COMPLETED AND TAKEN OVER PROVISIONALLY.

NAME OF WORK.	Sanction.	EXPENDITURE.		Date provisional reception.	NAME OF CONTRACTOR.
		1900.	To date.		
Markaz Simbellawin ... ..	1750	205	1593	3-1-00	Aly Badawi.
" Galioub ... ..	1720	307	1559	3-1-00	Badir Chenouda.
Residence, Director Medical School ... ..	3350	621	3235	4-1-00	Pezzi & Goussard.
Supplementary Works and Quarantine, Mex ... ..	906	758	893	12-5-00	N. Marciano.
Law Court & Prison, Mansour Palace ... ..	75846	15687	83827	12-5-00	Centonze, Marciano & Parbone.
Port-Saïd Governorate ... ..	5000	1862	4862	9-5-00	Zuro & Patouma.
Disinfecting Station ... ..	1050	860	878	27-11-00	Hamilton & Grant.
	89622	20300	96817		

DIRECTION, SPECIAL BUILDINGS, DELTA.

C.—WORKS IN PROGRESS.

NAME OF WORK.	Sanction.	EXPENDITURE.		Date fixed for completion.	NAME OF CONTRACTOR.
		1900.	To date.		
Egyptian Museum...	218953	43668	175358	12-01	Garozzo & Zaffrani.
Arab Museum...	53000	14307	34429	30-11-01	Marsili & Trehaki.
Geological Museum	4600	2713	2713	22-1-01	N. Marciano.
Lady Cromer's Memorial	3670	1346	1346	8-11-01	A. Trehaki.
Summary Tribunal, Chibin-el-Com	3360	703	703	29-8-01	Aly Badawi.
New Pavillion, Alexandria Hospital	4000	984	984	20-2-01	A. Trehaki.
Addition, Cuiro Post Office	12000	3882	3882	6-7-01	Guéfin & Charvaud.
Alexandria Coast Guard Stores	1800	1321	1321	10-1-01	" "
Alexandria Prison	—	7758	7758	—	M. Clure & Dorlain.
Tanta Prisons	—	11650	24282	1-12-99	E. Diamanti.
Prison & Hospital, Manchhia...	—	7734	23669	—	N. Prosperi. (Prison taken over finally).
Mehalla Kebira Tribunal and supplementary works.	115	—	—	10-1-01	Aly Badawi.
	301398	96066	276445		

## II.—SPECIAL WORKS, UPPER EGYPT, AND INSPECTION.

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Mr. Hewat now controls the ordinary inspection Works as well as his own Special Works.

The buildings completed in 1900 and still under construction are shown on accompanying statement.

Mr. Hewat reports favourably on the work of the European, but less on that on the Native Contractors in Upper Egypt.

There appears to be little temptation to attract the former class. They have been exposed to many petty vexations on the part of our Engineers, and one with whom we were very well satisfied has withdrawn after losing money.

The introduction of European Contractors on repairs work was initiated in 1900 with very good results. Severe measures are taken in cases where Engineers are proved to have caused loss to Contractors by inordinate delay in taking over works or in signing orders for payment.

The stolid opposition to the introduction of a new regime will only cease with the disappearance of the useless Chief Engineers for whose relegation to the category of pensioners we have so often petitioned.



## SOUTH INSPECTION

TABLE SHOWING THE SUMS EXPENDED ON WORKS FOR THE VARIOUS MINISTRIES DURING 1900.

MINISTRIES.	WORKS				TOTALS		REMARKS.
	Number	Expenses above £E. 200	Number	Expenses under £E. 200	Number	Expenses	
Interior ... ..	1	235	43	2,299	44	2,534	
Public Instruction ... ..	—	—	5	452	5	552	
Justice ... ..	—	242	13	482	15	724	
Finances ... ..	—	—	5	189	5	189	
Public Works... ..	—	—	4	113	4	113	
Foreign Office ... ..	—	—	—	—	—	—	
War Office ... ..	—	—	—	—	—	—	
Kkedivial Palaces ... ..	—	—	—	—	—	—	
Totals... ..	2	477	70	3,535	73	4,112	{ £E.1,600 was spent by the Beni-Souef Direction, and £E.2512 by the Sohag Direction.

DIRECTION BUILDINGS, BENI-SOUEF

WORKS	Estimate	Total	REMARKS
MINISTRY OF INTERIOR			
1. Markaz-el-Fachn ... ..	24.173		
2. Maison. Moudir Fayoum ... ..	252.612		
3. Moudirieh, Beni-Souef ... ..	39.226		
4. Markaz, Etsa ... ..	61.363		
5. „ Minieh ... ..	12.417		
6. „ Abou-Korkass ... ..	39.133		
7. Abattoir, Beni-Souef ... ..	21.747		
8. Markaz. Wasta ... ..	25.861		
9. Police, Wasta ... ..	98.248		
10. Markaz, Fayoum ... ..	104.007		
11. „ Samallout ... ..	43.183		
12. „ Beni-Mazar ... ..	39.090		
13. „ Beni-Souef ... ..	21.874		
14. Moudirieh, Fayoum ... ..	216.154		
15. Police, Abou-sir ... ..	23.047		
16. Markaz. Magaga ... ..	6.609		
17. Abattoir, Fayoum ... ..	1.461		
18. Hospital, Fayoum ... ..	3.149		
19. „ Beni-Souef ... ..	22.886		
20. Abattoir, Minieh ... ..	2.914		
21. Annexe Moudirieh, Fayoum ...	46.740		
Total £E. ... ..	1105.894	1105.894	
MINISTRY OF PUBLIC INSTRUCTION			
1. School, Minieh ... ..	213.538		
2. „ Beni-Souf... ..	0.462		
3. „ Fayoum ... ..	4.417		
Total £E. ... ..	218.417	218.417	
<i>Carried forward</i> £E. ... ..		1324.311	

Paid by Irrigation  
Department.

DIRECTION BUILDINGS, BENI-SOUF—*Continued.*

WORKS	Estimate	Total
<i>Brought forward £E. ... ..</i>		1324,311
MINISTRY OF JUSTICE		
1. Tribunal, Fayoum ... ..	58,040	
2. Mehkemeh Charieh, Fayoum ...	18,468	
3. Tribunal, Beni-Souef ... ..	24,924	
4. „ Minieh ... ..	5,368	
5. Mehkemeh, Charieh Wasta ... ..	7,008	
Total £E.... ..	113,808	113,808
MINISTRY OF FINANCES		
1. Office Chichnagui, Fayoum ... ..	84,211	
2. Post, Beni-Mazar ... ..	25,242	
3. „ Fachn ... ..	25,000	
4. „ Minieh ... ..	8,987	
Total £E. ... ..	143,440	143,440
MINISTRY OF PUBLIC WORKS		
1. Tanzim Office, Minieh ... ..	17,747	
Total £E. ... ..	17,747	17,747
General Total £E. ... ..		1599,306



DIRECTION BUILDINGS. SOHAG.

WORKS	Estimate	Total	REMARKS
MINISTRY OF INTERIOR			
1. Markaz. Guergueh... ..	65.294		
2. „ Louxor ... ..	31.237		
3. Abattoir. Guergueh ... ..	4.863		
4. Markaz. Keneh ... ..	33.918		
5. „ Sohag ... ..	168.596		
6. Moudirieh, Assiout ... ..	90.047		
7. „ Keneh ... ..	71.591		
8. Abattoir, Keneh ... ..	5.528		
9. Police, Draw ... ..	19.500		
10. Moudirieh, Sohag ... ..	129.407		
11. Markaz, Tèmar ... ..	142.240		
12. „ Manfalout ... ..	51.164		
13. „ Badari ... ..	61.454		
14. Prison, Keneh ... ..	125.633		
15. Hos-pital, Keneh ... ..	45.518		
16. Markaz, Assiout ... ..	156.166		
17. Police, Sedfa ... ..	3.399		
18. Markaz, Aboutig ... ..	10.000		
19. Moudirieh, Assouan ... ..	100.000		
20. Abattoir, Sohag ... ..	6.330		
21. Maison, Moudir Sohag ... ..	46.214		
22. Wells on Kosseir road ... ..	60.000		
Total £E. ... ..	1428.099	1428.099	
MINISTRY OF PUBLIC INSTRUCTION			
1. School, Edfou ... ..	159.000		
2. „ Sohag... ..	173.890		
Total £E. ... ..	332.890	332.890	
Carried forward £E. ... ..		1760.989	

DIRECTION BUILDINGS, SOHAG—*Continued.*

WORKS	Estimate	Total	REMARKS
<i>Brought forward £E.</i> ... ..		1760.989	
MINISTRY OF JUSTICE			
1. Tribunal, Mallaoui ... ..	49,628		
2. Mehkemeh, Charieh Mallaoui ...	6,713		
3. Tribunal, Guergueh ... ..	281,010		
4. „ Nagh-Hamadi ... ..	14,471		
5. „ Dechna ... ..	100,000		
6. „ Keneh ... ..	84,635		
7. Mehkemeh, Charieh Assouan ...	20,226		
8. Tribunal, Sedfa ... ..	0,785		
9. Mehkemeh, Charieh Kosseir... ..	22,000		
10. „ „ Kroskou ... ..	30,000		
Total £E. ... ..	609,468	609,468	
MINISTRY OF FINANCES			
1. Office Chichnagni, Keneh ... ..	46,000		
Total £E. ... ..	46,000	46,000	
MINISTRY OF PUBLIC WORKS			
1. Tanzim Office, Assiout ... ..	19,294		
2. Landmarks indicating the course to be kept by Luxor boats ... ..	2,002		
3. Irrigation Office at Sohag ... ..	73,980		
Total £E. ... ..	95,276	95,276	
General Total £E. ... ..		2511,733	

Paid by the Irriga-  
tion Department.

Beni-Souef... .. £E.1509,306

Sohag ... .. „ 2511,733

Total ... .. £E.4111,039

### III.—INSPECTION NORTH.

In all but five of the eighteen towns subject to Tanzim regulations, Local Commissions have been instituted, of these five (viz. Guizeh, Menouf, Kuesna, Port-Saïd and Rosetta) the first two will follow the majority in 1901. The divided authority under which the Tanzim Engineer works and the desire of the Local Boards to break through what they regard as a web of delay and circumlocution spun by the Public Works Department, has resulted in some instances in a successful evasion of technical control and a consequent mutilation of projects and waste of money.

When I speak of technical control I refer to the check which should be exercised by our Head Office. The Local Tanzim Engineer has by Arrêté Ministériel of the 27th December, 1888, been ordered (with the usual result) to serve two masters. I have already explained that these Engineers are technically incapable of designing or executing any but the simplest projects.

Saïd bey Choucri reports as follows:—

“J’ai remarqué, dans le courant de cette année, que parmi ces “Commissions Locales il y en a qui dérogent aux Règlements régissant “les Commissions notamment en ce qui concerne les projets des “travaux techniques que les Commissions négligent de soumettre à “l’examen du Ministère des Travaux Publics pour les compléter, s’il “y a lieu, avant de les approuver”.

“Cette négligence de la part des Commissions Locales fut souvent la “cause de mauvais emploi de crédits dont on aurait pu profiter en faisant “un meilleur usage; d’ailleurs, cet inconvénient a été suffisamment “démonstré dans les lettres que le Ministère a adressées à l’Intérieur “(Commission Supérieure) à la suite de mes rapports à ce sujet”.

“La cause de cette irrégularité pourrait être due à un sentiment “d’indépendance qu’éprouveraient les Présidents des Commissions “Locales, même pour les travaux qui sortent de leurs attributions et “de leurs connaissances; ou bien à une simple négligence de la part “des Présidents des Commissions, ou à l’ignorance de leurs devoirs “dans la matière”.

“Les Commissions Locales semblent compter suffisamment, pour la “bonne exécution de leur travaux sur les Ingénieurs du Tanzim; mais “l’assurance que leur procure le concours de ces Ingénieurs est “illusoire, car il a été remarqué, plus d’une fois, que ces Ingénieurs “n’osent formuler aucune objection aux idées manifestées par les “Moudirs et Gouverneurs qui sont les Présidents des Commissions et, “en même temps, leurs Chefs Administratifs; de là encore une fois, le “mauvais emploi des fonds dont on pourrait tirer un grand profit avec “un meilleur emploi”.

I thoroughly agree with his remarks.

The remedy I have frequently proposed consists in the formation of a fund by deducting 10% from the aggregate Municipal Budgets.

This sum should be placed at the disposal of the Public Works Department to pay for the formation of a staff to be occupied solely in designing and executing projects proposed by the Local Commissions.

It is only fair to state that in some instances where local talent has been employed and where gratuitous prison labour is available, results have been obtained which in economy could not have been improved on, even under Public Works Department's direct supervision. Aswan, where a certain amount of good granite macadam has been laid, forms a case in point. This fact does not, however, alter my opinion as to the necessity for the introduction of a general system of close technical control. Such supervision can only be relaxed when the appointment of efficient Local Tanzim Engineers permits of decentralisation.

On the whole, improvements have undoubtedly resulted, if not directly, from the institution of Parish Councils, still by reason of the increased spending powers which their creation has rendered possible. In the interests of ultimate economy I cannot agree with the plea generally advanced that it is better to do a great deal of work of an inferior quality than a little work of a permanent character. The Zagazig Council insisted on the purchase of very thin rain-water tubes instead of the normal thick Angus Smith coated pipes proposed by the Tanzim. The former are too thin to stand caulking. They leak and will be corroded in two years. The latter in ordinary soil last forty years. The difference of price or apparent economy was £E.0·83 per metre. The real loss on forty years is £E.2·25 per metre.

The most serious waste occurs when a technically ignorant local Tanzim Engineer endeavours to execute without reference to Head-Quarters projects suggested by the energetic inexperience of a Parish Council. Such a case occurred at Kenah during my absence on leave. Very considerable blame here attaches to the Tanzim Inspector, though the difficulties created by the condominium to which I have referred, by the ignorance of the local Engineer and by breaches of regulations committed by the Mudir must be considered in extenuation. An untimbered trench 35 feet deep was dug, on a rising flood, from the Nile to the pumping station for the reception of a suction pipe. The latter consists of very thin wrought-iron pipes which can scarcely sustain the pressure of the superincumbent earth and which would corrode in a year. The pump room, which is 6 feet below high Nile, was built of Beledi brick and inferior mortar. The bed-plates of engine and pumps were designed to rest on mule earth. The dam made to keep out the rising Nile broke. 200 metres of trench were silted up to a depth of 15 feet, and a brick well and several lengths of pipe were swept away. The contractor chosen by the Mudir was quite incapable of carrying

out this difficult, though small, hydraulic work. The Mudir being unwilling to break the contract we were obliged ourselves to take the necessary steps. Mr. Hewat has redesigned the work and a European contractor has been charged with its execution. A considerable deficit will result in this case and in all cases where the unsound conditions obtain to which I have alluded.

Mansourah, endowed with a limited Municipality, has established an electric light station and is executing a rain drainage project designed by the Public Works Department and estimated at £E.3,000.

Though they have an Engineer of their own, we have at their special request charged a Head-Quarters Engineer with the supervision. All towns except Mansourah and Port-Saïd are lighted with oil or petroleum.

Nine towns possess no paved streets; four are just beginning to macadamise, and five can boast of a few kilometres of macadam and flag pavement.

An idea of the quality of the buildings constructed by the inhabitants may be gained by casting a glance at the number of demolition orders. 374 of these were submitted to the Courts in 1900 for eighteen towns.

On the other hand, 1,528 permits for the construction of new houses were issued.

#### ALEXANDRIA QUARRIES.

The rating of Quarry dues was until lately based on the area exploited.

A change was rendered imperative by the practice, followed by every tenant, of surreptitiously extending his limits. When convicted, a nominal fine was imposed by the Courts, who thus place a premium on evasion of the law.

The new system consists in charging an Octroi duty on the contents of every cart of stone brought into Alexandria.

The result financially has been unexpectedly favourable.      £E.

In the first 5 months of 1900 (old system) a sum was encashed of      266

In the second 5 months      ...      ...      ...      ...      ...      ...      ...      1,552

The new dues have up to the present fallen on the carter and a strike has resulted.

The proper incidence of this taxation will no doubt be adjusted by the operation of the law of demand and supply.

The tax will probably be ultimately borne by the Contractors for building, and be shifted by them on to the shoulders of those for whom the construction is intended. I am of opinion that the tax should be maintained.

DÉTAIL DES DÉPENSES EFFECTUÉES EN 1900 POUR TRAVAUX DE TOUTE NATURE EXÉCUTÉS AUX BATIMENTS DE L'ÉTAT.

MINISTÈRES	BASSE-EGYPTE				HAUTE-EGYPTE				GRAND TOTAL
	Travaux neufs.		Réparations.		Travaux neufs.		Réparations.		
	Total.		Total.		Total.		Total.		
Intérieur ... ..	1037	—	5756	—	6793	—	2561	—	9354
Services Sanitaires ... ..	378	—	1714	—	2092	—	500	—	4434
Instruction publique ... ..	621	—	4095	—	4716	—	251	—	10775
Justice ... ..	1250	—	2392	—	3642	—	1108	—	7375
Finances ... ..	546	—	3771	—	4317	—	660	—	1977
Travaux publics ... ..	1547	—	7663	—	9210	—	420	—	9855
Totaux...	5379	—	25391	—	30770	—	5500	—	46770

TABLERAU N° III.

PRODUITS DE LA VENTE DES VIEUX MATÉRIAUX.

INSPECTION DU NORD.				
Direction du Caire.	Direction de l'Est.	Direction du Delta.	Direction de l'Ouest.	Total.
L.E.	L.E.	L.E.	L.E.	L.E.
32,175	19,161	21,500	77,066	149,902

TABLEAU N° V.

TABLEAU INDICANT LES TRAVAUX DES INGÉNIEURS DU TANZIM DES PROVINCES DURANT L'ANNÉE 1900 (TANZIM VOIRIE).

BI ELAFI DU TANZIM	ENTRETIEN DES ROUTES OU CHAUSSEES										ECLAIRAGE		EMPLOI PAR LES PARTICULIERS DES VOIES PUBLIQUES			RECETTES DE VOIRIE
	Arrosage		Balayage		Réparations				Système	Nombre des lampes	Rols subs					
					Ordinaire	Remblais	Macadam ou balai	Trottoirs			de contravention	Pour boulangerie	Pour construction			
	Surface des rues	Surface des routes	Cubo	Surface										Surface		
	Nombre des voitures	Surface des rues	Nombre des voitures	Surface des rues	Ordinaire	Remblais	Macadam ou balai	Trottoirs								
Helouan ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Guisch ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Benha ...	3	37000	3	131200	—	1680	355	—	—	—	—	—	—	1	16	7,354
Mansoura ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zagazig ...	8	138460	5	166764	13120	876	—	—	—	—	Pétrole, Electricité.	350	—	—	—	—
Port-Saïd ...	10	333305	49	333305	121700	5191	64139	12	3420	—	Pétrole.	202	5	174	—	97,100
Suez ...	6	86682046	4	66755308	907	7850	598	3230	—	—	Gaz.	338	355	333	11	266,417
Damiette ...	4	31646	27	36845	4620	1212	2071	1065	—	—	Huile.	119	—	128	44	98,235
Tanta ...	9	123350	8	135210	60812	1403	13312	13444	—	—	Pétrole.	339	6	1	—	7,074
Kafr-el-Zayat ...	3	61375	2	47442	5594	459	313	—	—	—	Pétrole.	296	57	668	20	635,045
Chibin-el-Kom... Menouf ...	4	30000	2	35000	12850	5900	—	—	—	—	Huile.	75	—	—	—	—
Kowesha ...	—	—	—	—	—	—	—	—	—	—	Huile.	75	4	29	—	30,029
Mchalla ...	4	64525	2	80113	61525	1192	300	—	—	—	—	—	—	—	—	5,000
Zifta ...	5	451800	1	795684	120894	—	—	—	—	—	Pétrole.	152	2	131	99	130,098
Mit-Ghamr ...	4	417492	4	495181	50292	4837	—	—	—	—	Huile.	948	3	55	14	57,012
Damanhour ...	7	52000	3	72700	33960	350	1365	—	—	—	Huile.	960	2	73	2	73,002
Rosette ...	—	—	—	—	—	—	—	—	—	—	Pétrole.	180	2	61	2	31,365

TABLEAU N° V (bis).

TABLEAU INDICANT LES TRAVAUX DES INGÉNIEURS DU TANZIM DES PROVINCES DURANT L'ANNÉE 1900 (TANZIM DIVERS).

BUREAU DU TANZIM	TANZIM										TRAVAUX DIVERS						NOMBRE DES CORRESPON- DANCES		RECETTE DE TANZIM
	Permis de constructions		Bâtimens mécaniques		Plans				Machines à vapeur		Bâtimens de l'Etat		Service Sanitaire		Surveillance des travaux		Arrivée	Depart	
	Reparations	Process- verbaux	Procès-verbaux de constatations	Procès-verbaux de démolitions	de terrain rentrant dans l'aménagement		de terrain sortant de l'aménagement		Plans	Plans ou dessins	Rapports et devis	Plans de clinetres	Constatation de nappe d'eau souterraine	Pour Direction des Travaux	Pour Commission				
					de constatations	de contraventions	Nombre	Surface								Nombre			
Hélovan ...	16	50	60	—	—	—	1	127	16	128	—	—	—	—	—	—	250	305	25,840
Guisch ...	40	25	15	—	—	—	4	63	8	125	2	—	—	15	—	—	—	—	20,490
Bouba. ...	11	37	76	—	—	—	9	181	8	210	—	6	14	20	—	9	378	376	21,220
Mansoura ...	110	119	179	10	26	9	9	87	1	10	—	14	65	55	—	64	1169	1256	60,420
Zagazig ...	105	50	114	11	36	1	1	87	1	10	1	9	4	20	17	48	1107	1533	52,840
Port-Saïd...	171	69	114	—	—	—	—	—	—	—	—	17	78	2	—	36	1886	2107	190,330
Suez ...	31	57	24	—	—	—	6	160	2	60	—	—	19	60	1	47	732	811	27,740
Damiette ...	100	18	79	—	—	—	35	823	9	130	—	—	6	1	—	4	632	782	16,140
Tanta ...	169	150	213	12	17	17	17	715	41	635	1	3	19	68	31	44	801	1079	180,000
Kafr-el-Zayat...	15	35	45	—	3	3	8	120	3	21	—	10	13	6	—	5	390	391	15,000
Chibin-el-Kom.	151	75	203	11	24	10	10	51	99	822	—	9	22	2	13	45	777	753	113,000
Menouf ...	92	31	39	7	10	2	8	11	—	—	—	3	1	—	—	—	—	—	91,000
Koyesna ...	8	—	1	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	8,000
Mehalla ...	181	74	223	1	3	—	21	121	—	—	3	13	3	1	41	12	519	550	183,000
Zaïta ...	38	30	58	11	19	3	3	11	—	—	—	—	—	1	15	—	433	433	37,900
Mit-Ghamr ...	10	12	69	9	16	3	3	35	11	—	—	1	—	—	—	—	292	306	40,000
Damanhour ...	132	64	96	18	25	49	49	384	33	28	—	—	16	83	48	36	905	1115	57,000
Rosette ...	55	36	21	1	9	11	11	270	—	—	—	—	—	—	—	—	148	120	25,000



#### IV.—ARCHITECTS' DEPARTMENT.

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##### DRAWING OFFICE.

Sixty-three projects estimated at £E.280,000 and necessitating the preparation of 878 plans were designed in 1900.

The Staff expenses amounted to £E.4,710 or 1·68% on the estimated value of works, showing that this Service is very short handed.

Several regrettable and expensive mistakes have occurred in consequence.

In Europe at 2½% the preparation of the above projects would have cost £E.7,000.

The constructive “voltes-face” which the Architects' Department is constantly called upon to make in the endeavour to satisfy the changing requirements of Heads of Departments is the most fruitful source of error, especially as speed of design and execution is invariably insisted on.

Every species of lime, cement, brick, and building stone in England has its own published tests for crushing and tensile strength, certified by the highest expert authorities. Prices and constants of labour in infinite detail for every variety of work, excavation, brick-laying, masonry, paving, carpenter's work, joinery, ironmongery, tiler's, plasterer's, plumber's work, smithing, foundry, zinework, painting and glazing, may be found in any engineering or architectural pocket book. All these details have to be elaborated in our office unless we prefer to blindly confide in a contractor.

Thus Architects in Europe can draw on the tabulated experience of years, and refer to expert contractors in every branch of Engineering. If in this case absolute accuracy is unattainable it is not wonderful that our heterogeneous collection of draughtsmen and designers confronted with intricate and ever-varying problems should fall short of the desired standard.

In France, contracts are framed so as to throw on the contractor all responsibility for errors and omissions in the plans and adjudication documents.

The possibility of error is thus reduced to a minimum.

Contractors are further, by this means, prevented from making capital out of accidental omissions or miscalculations.

The qualifications required in our Designing and Executing Staff are such as are rarely found in combination. The subjects presented to the Tanzim comprise: Architecture, Building, Water-works, Drainage of cities, Road construction, Horticulture, Tramways, Ironwork, Light Railways, study of "Béton Armé," Duties on Building Materials, Scavenging-Watering, Conservancy, Electric Lighting reporting on patent systems of lighting, such as Gas, etc., etc.

In the category "Architecture" and "Building" are comprised projects ranging from the designing of Palaces, Museums and Courts of Justice, through Fire Brigade Stations, Prisons, Hospitals and Barracks to Latrines and Cages for Wild Animals.

ÉTAT DU CRÉDIT OUVERT EN 1900 PAR LA CAISSE DE LA DETTE PUBLIQUE  
POUR LA "CONSTRUCTION DE DIVERS BATIMENTS PUBLICS."

DÉSIGNATION	Crédits.		Dépensé au 31 décembre 1900.		Solde.	
Nouveau Musée de Géologie ... ..	5300	—	2712	789	2587	211
Local reproduction des plans ... ..	2800	—	1028	165	1771	835
Nouveau bureau à Tanta ... ..	2100	—	—	—	2100	—
Gouvernorat de Port-Saïd ... ..	15000	—	1862	322	13137	678
Hôpital de Port-Saïd ... ..	5000	—	38	900	4961	100
Hôpital maladies infectieuses d'Alexandrie	5000	—	983	650	4016	350
Modifications Asile Aliénés ... ..	2500	—	2500	—	—	—
Prison Manchieh (Bât. Access.) ... ..	7200	—	6832	170	367	830
Prison Beni-Souef (Bât. Access.) ... ..	3900	—	3879	005	20	995
Prison Tanta (Bât. Access.) ... ..	800	—	782	355	17	645
Prison Alexandrie (Bât. Access.) ... ..	10100	—	7758	240	2341	760
Caserne Police Quais Alexandrie ... ..	1900	—	—	—	1900	—
Hôtel des Postes au Caire ... ..	10500	—	731	713	9768	257
Tribunal Sommaire Mansourah... ..	3500	—	80	—	3420	—
Tribunal Sommaire Chibin-el-Kom ... ..	3500	—	703	480	2796	520
Cage des éléphants ... ..	1900	—	1466	200	433	800
En tout... ..	81000	—	31359	019	49640	981

TABLE SHOWING THE FAIR PERCENTAGE OF ESTABLISHMENT CHARGES IN PREPARATION OF DESIGNS FOR  
IMPORTANT PROJECTS CARRIED OUT IN 1900.

Order.	Works.	Value.	Project Rate of %	Amounts of %	Order.	Works.	Value.	Project Rate of %	Amounts of %
1	Arabic Museum; uncompleted project	7500	—	225	1	Sanieh School, Cairo	32000	3%	968
2	Dairy and cow-shed ... ..	2300	3%	69	2	Alterations, Post-Office Cairo ...	14000	2%	280
3	Elephant cage ... ..	1800	2%	36	3	Tanzim, Tanta ... ..	2100	5%	105
4	Enlargement of the Post-Office ...	8500	4%	340	4	Tanzim, Zagazig ... ..	1900	5%	95
5	National Printing Office ... ..	7500	1%	75	5	Tanzim, Pavillon ... ..	500	2%	10
6	Lunatic Asylum ... ..	500	3%	15	6	Mansourah Tribunal ... ..	3500	1%	110
7	Reservoirs, Matariéh... ..	750	5%	37	7	Chibin-el-Kom Tribunal ... ..	3500	1%	110
8	Lady Cromer's Memorial... ..	1500	3½%	50	8	Mr. de Maspero's House ... ..	4000	1%	160
9	Columns and "Py lone," Karnak ...	5000	1%	50	9	Scavenging and Watering Service Stables ... ..	18000	3%	540
10	Hospital, Minieh ... ..	750	3½%	25	10	Geological Museum ... ..	5350	1%	53
11	Photographic Studio; Ghizeh ...	1870	5%	94	11	Special Works Offices ... ..	432	5%	21
12	Tobacco Store, Alexandria ... ..	10000	3½%	350					
13	Agricultural School, Ghizeh ... ..	18000	3%	540		Total 2nd Section... ..	85282	2.94	2505
14	Lion cages, Ghizeh ... ..	3000	5%	180					
15	Post-Office, Port-Saïd ... ..	25000	3%	750					
16	Law School... ..	25000	3%	750					
17	Mosque, Mohamed Aly ... ..	5000	1%	50					
18	Pavillon, War Office... ..	500	3%	15					
19	Assiout Tribunal ... ..	—	—	—					
20	Fire Brigade Barracks ... ..	25000	3%	750		Total 1st Section ... ..	194120	...	5595
21	Custom House Shed, Alexandria ...	7500	4%	300		" 2nd " ... ..	85282	...	2505
22	Egyptian Museum of Antiquities ...	6650	3%	200		General total... ..	279402	...	8100
23	Prison for persons awaiting trial ...	1500	3½%	50					
24	Gouvernorat, Port-Saïd ... ..	15000	3%	450					
25	Pavillon, Barrage ... ..	2500	4%	100					
26	Installation of the "Palais de Justice"	8000	1%	80					
27	Tanzim Office, Fayoum ... ..	1400	1%	14					
	Total 1st Section... ..	194120	2.88	5595					

SUMMARY.

Total 1st Section ... .. 194120 ... .. 5595  
 " 2nd " ... .. 85282 ... .. 2505  
 General total... .. 279402 ... .. 8100

The Salaries of Employés of the Architectural Department for  
 1900 amounted to £E.4710

or %  $\frac{4710}{279402} = 1.68\%$ , actual percentage spent.

## V.—ROADS •

In view of the many demands made for the construction of new roads and for the up-keep of others, I would again draw attention to the following facts (Statements A to F).

The Voirie budget admits of the maintenance of 385,000 sq. met. p.a. The main traffic streets being exposed to the heaviest wear and tear are necessarily those on which our budgetary resources must be exclusively concentrated.

The area of these streets is 555,000 sq. met.

Our total budget therefore only covers 70 % of the main thoroughfares.

The ratio of main traffic to the whole street area of Cairo is as

$$\frac{550,000}{2,781,741} \quad \text{or say } 20 \%.$$

The hard fact remains therefore that after reducing unit rates to a minimum, only 14 % of the area for which the Tanzim is liable can be maintained with our present budget. It follows further that about 86 % of the population of Cairo will continue to complain of the state of the streets in their neighbourhood.

I have concentrated our funds on as large a proportion as possible of important thoroughfares. We have now therefore some good roads, and dissatisfaction is limited to the neglected balance.

One of the chief absurdities of the present system is the taxation of our utterly inadequate city budget on behalf of 373,361 sq. met. of purely suburban roads. Equivalent to 45 kilometres in length.

Statement No. D and F gives full details. I think a glance at this statement will show that the present system is the one which distributes in the most economical manner our absurdly inadequate funds.

It would save this Department much trouble if the Government would in some public manner dispose of the fallacy entertained by 90 % of European as well as native householders—that the payment of 8 % house tax gives them the right to roads, trottoirs and gas.

It is often laid to our charge that the available funds are spent entirely on the European quarter. This idea again rests on a misapprehension. Heavy wheel traffic necessarily follows the widest and

best maintained streets. Certainly 80 % of the carts which pass through the so-called European quarter belong to natives or benefit native labour.

51 % of the total street area is unpaved. Of this 33 % is roughly levelled annually.

49 % of the street area is paved in a fashion.

28 % of this area, or as previously stated, 14 % of the total street area is annually maintained.

The supply of basalt by the Prisons Department has been conducted in a very satisfactory manner.

The general progress of the Service may be judged from the accompanying comparative statistics.



TABLE SHOWING DIFFERENT KINDS OF ROAD SURFACES.

	AREAS.					Total metalled roads.	Total of earth roads.	Area of the City roads.
	Bad roadways, old system.	Bad roadways, old system remade in basalt.	Earth roads remade in limestone	Roads newly erected made in limestone.	Roads in compressed asphalt bricks.			
	I	II	III	IV	V	VI	VII	VIII
1896 ... ..	1,235,250	—	—	—	4,875			27,499.70
1897 ... ..	1,200,883.49	34,366.53	14,073.13	4,431.	—			
1898 ... ..	1,105,066.74	95,816.73	11,371.92	12,217.51	—			
1899 ... ..	1,027,468.19	77,598.55	41,103.31	15,123.25	—			
1900 ... ..	973,323.29	54,141.90	15,595.19		1,607			
Deduct 1,607 M <sup>2</sup> , first made in basalt, converted into asphalt bricks in 1900		261,926.71						
		1,607.—						
Total 1900... ..	973,323.29	260,319.71	82,113.55	31,771.76	6,482	1,354,040.31	1,427,701.45	2,781,741.76
								31,771.76

Increased area since December, 1896 (see column IV) ... ..

From the foregoing it results:—

	Sq. met.
1. That the total area of roads in the city is (Col. VIII) ...	2,781,742
2. That same area was at end of December 1896 of only (Col. VIII) ... ..	27,499.70
3. That the roads created from 1897 to 1900 are (Col. IV) ...	31,772
or an increase in 4 years of ... ..	1.15%
4. That the total area of earth roads remaining to be paved is (Col. VII) ... ..	1,427,701
or a proportion on the total area of the town ... ..	51.32%
5. That the total area paved in different systems is (Col. VI) ...	1,354,040
or a proportion on the total area of the town ... ..	48.68%
6. That the total area of roads macadamised in the old system is (973,323 + 82,144 + 31,772) (Cols. I, III, IV) ...	1,087,239
and that the roads re made in basalt represent an area of (Col. II) ... ..	260,320
The proportion of good roads to bad is ... ..	23.9 or 24%
7. If we consider that the above proportion has been reached in 4 years, it will then require 16.66 or say 17 years, to remake the 973,323 sq. met. shown at Col. I.	

## ASPHALT BRICK PAVEMENT.

### Construction.

Only one road was paved, that round the National Bank, a surface of 1,607 sq. met., which cost £E.1,086. or £E.0.739 mill. per sq. met.

The National Bank paid £E.524 towards this; the difference, £E.662, was paid from our budget.

Bricks manufactured by “*The Société Civile des Mines de bitume et d’asphalte du Centre*,” and “*The Société Générale d’asphalte de France*,” were employed in this work; we shall therefore be able to see which wear the better.

## REPAIRS AND MAINTENANCE OF PAVEMENT KERBS.

During the year 7,930 metres of kerbs and gutters have been relaid at the cost of £E.191.

Below is the rate per lin. met. for this and the three previous years.

	1897	1898	1899	1900
(A) The rate for materials per lin. met. is...	0.0055	0.0037	0.0086	0.0176
(B) “ labour “ “ is...	0.0063	0.0068	0.0058	0.0072
(C) “ carts “ “ is...	0.0004	0.0001	0.0002	0.0005
(D) Total per lin. met. is ... ..	0.0122	0.0106	0.0146	0.0253



The kerbs and gutters require to be replaced throughout, with the exception of 12,000 metres. There are 120,000 metres, so that 108,000 metres have to be done.

In relaying the same 47,000 lin. met. each year during the last four years only 4,915 metres have been replaced by new stones for reasons of economy.

The percentage of stone which had to be replaced was as follows:—

1897	...	...	...	...	...	...	...	...	...	2 %
1898	...	...	...	...	...	...	...	...	...	2·3%
1899	...	...	...	...	...	...	...	...	...	5 %
1900	...	...	...	...	...	...	...	...	...	9·6%

This shows that the kerbstones are deteriorating at a quick rate, and it is therefore desirable to increase largely the funds available for this work.

This unsatisfactory state of affairs is due to the bad quality of the stone employed when the kerbs were first laid some years ago.

#### DRESSING EARTH ROADS AND PATHWAYS.

During the year:—

						£E.
316,800	sq. met. of earth roads were dressed costing	...	...	...	...	264
and 156,480	sq. met. of pathways costing	...	...	...	...	204

						1900
(a)	The rate for dressing roads is, per 100 sq. met.	...	...	...	...	83 mill.
(b)	The rate for dressing pathways is, per 100 sq. met.*	...	...	...	...	130 mill.
(c)	The area of road dressed by 1 man per day is	...	...	...	...	102 sq. met.
(d)	The area of pathway dressed by 1 man per day is	...	...	...	...	110 sq. met.

The mean area dressed during the last four years is 604,944 sq. met., or rather 304,472 sq. met. were dressed twice over each year, this being the part where the traffic is heaviest. This is only 21·18  $\frac{0}{0}$  on the whole area of the earth roads.

In spite of every possible care these roadways are most unsatisfactory.

#### MENDING BASALT ROADS.

In 1898, 16,037 sq. met. were mended by the	£E.	Mill.
steam roller costing...	...	849 or 53 per sq. met.
In 1899, 81,779 sq. met. were mended by the		
steam roller costing...	...	2,681 or 33 ..
In 1900, 78,827 sq. met. were mended by the		
steam roller costing...	...	1,883 or 24 ..

\* This rate includes the cost of sand spread on the pathways for the Mohamedan fetes.



# PERCENTAGE.

YEARS.	Materials, stone, sand, water. %	WORKMANSHIP.				Rolling. %	Cost, per sq. metre.
		Labourers. %	Water Carts %	Carts. %	Total %		
1898	73·5	11·2	0·09	6·60	18·70	7·80	61
1899	67·4	11·2	1·20	9·80	22·20	10·40	36
1900	54·7	16·8	1·80	9·10	27·70	17·60	33

As in case of the basalt roads, there has been an improvement in the cost of mending these 2nd class roads in limestone.

## MENDING ROADS BY HAND.

205,163 sq. met. were repaired by hand this year which cost £E.2,165 or 10·6 mill. per sq. met.

	1897	1898	1899	1900
1. Thickness of stone per sq. met. ... ..	0·033	0·029	0·029	0·031
2. Proportion of sand per cub. met. of stone ... ..	0·278	0·270	0·263	0·275
3. Cube of water consumed per cub. met. of stone ... ..	0·455	0·417	0·394	0·382
4. Cube of water consumed per sq. met. repaired ... ..	0·015	0·012	0·011	0·012
5. Mean area repaired per labourer's day ... ..	14·71	19·92	20·85	19·87
6. Cost of materials per sq. met. repaired ... ..	0·0087	0·077	0·0048	0·0050
7. Cost of road labourer per sq. met. repaired ... ..	0·0040	0·0025	0·0025	0·0025
8. Total cost per sq. met. mended ... ..	0·0052	0·0122	0·0092	0·0106

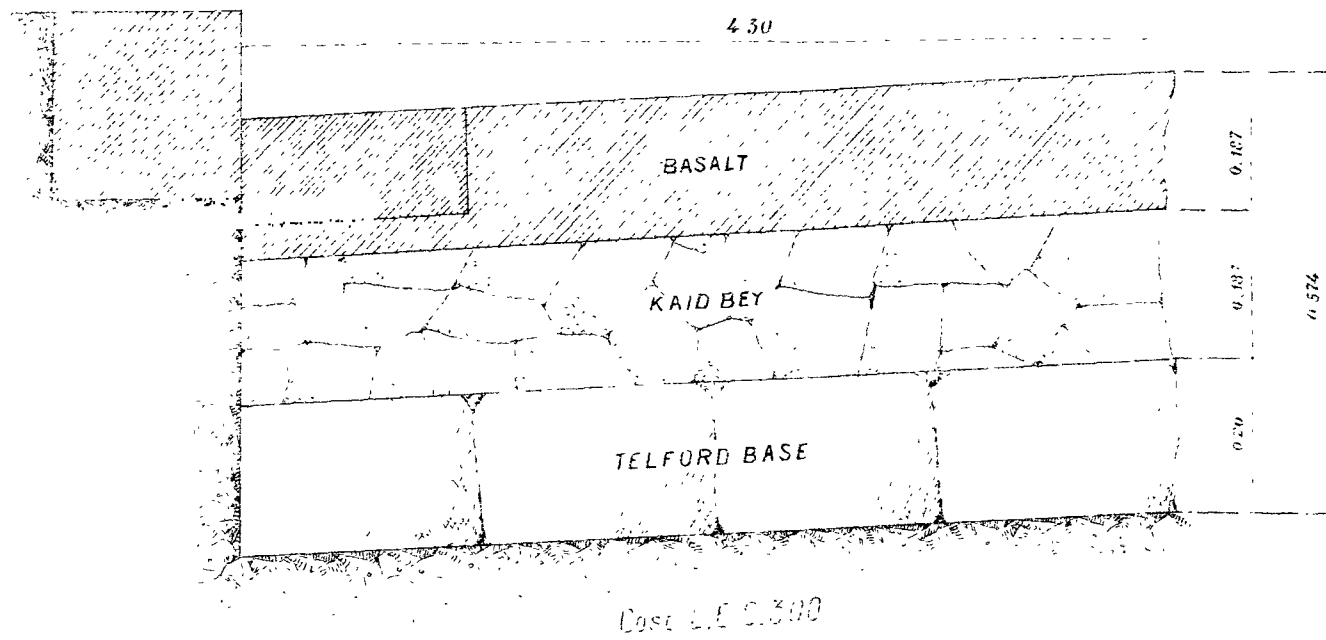
# PERCENTAGE.

YEARS.	Materials, stone, water, sand %	WORKMANSHIP.				Cost per sq. met.
		Labourers %	Watering men, and water carts. %	Carts. %	Total. %	
1897	58	25	6·7	9·8	42	0·0152
1898	63·1	20·7	4	12·2	36·9	0·0122
1899	51·6	26·9	4·3	17·2	48·4	0·0093
1900	47·2	24	5·7	23·1	52·8	0·0106

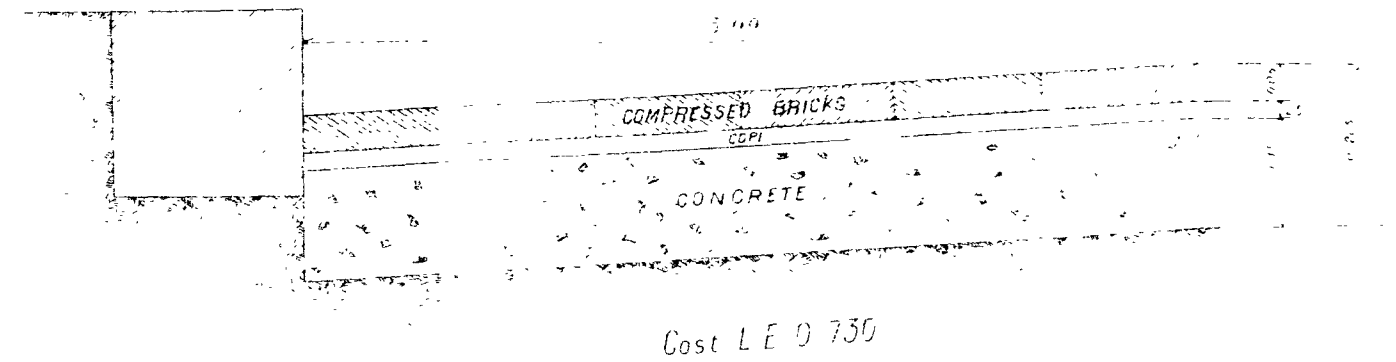
# TYPES OF PAVING EMPLOYED FOR THE ROADS OF CAIRO.

Scale  $\frac{1}{10}$

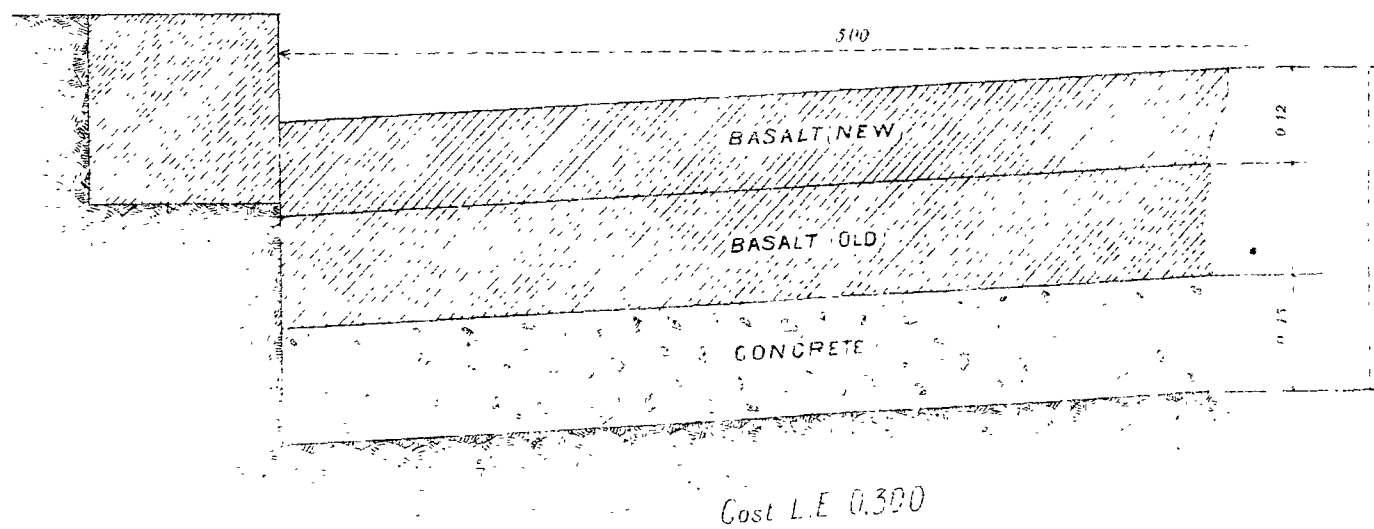
BASALT ON TELFORD BASE (ABANDONED).



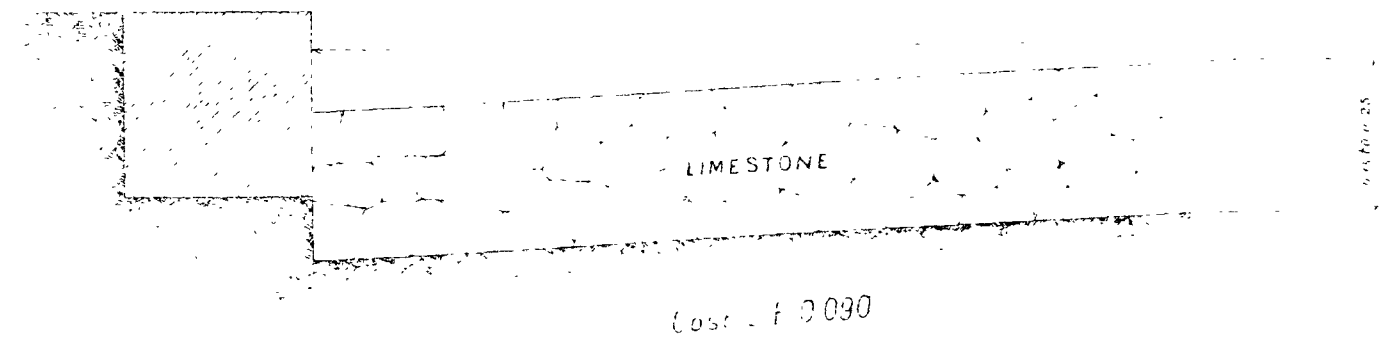
COMPRESSED ASPHALT BRICKS.



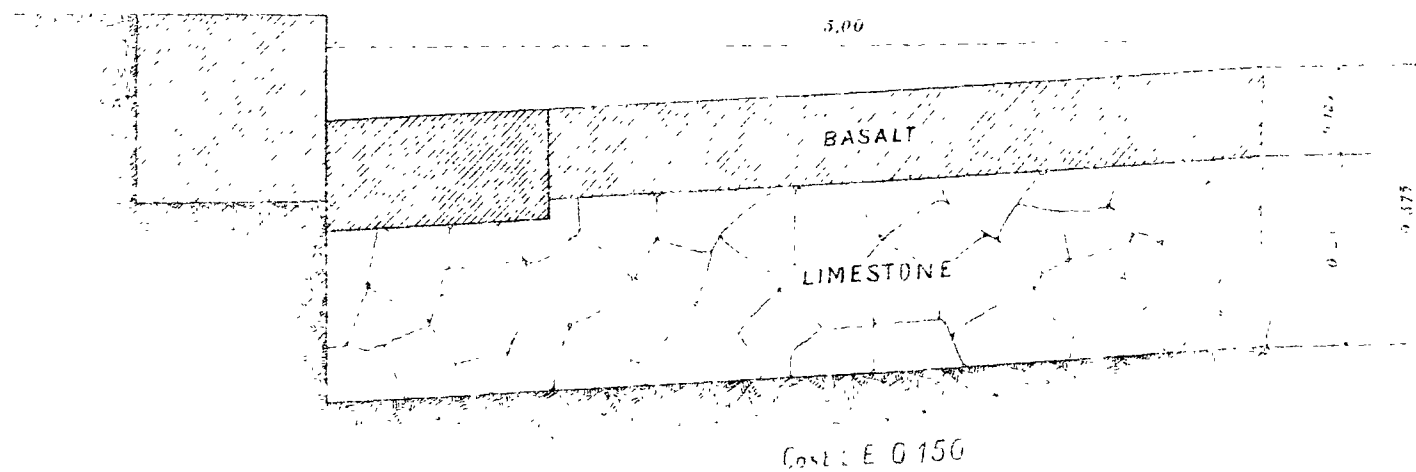
BASALT ON CONCRETE BASE OF OLD WOOD PAVING



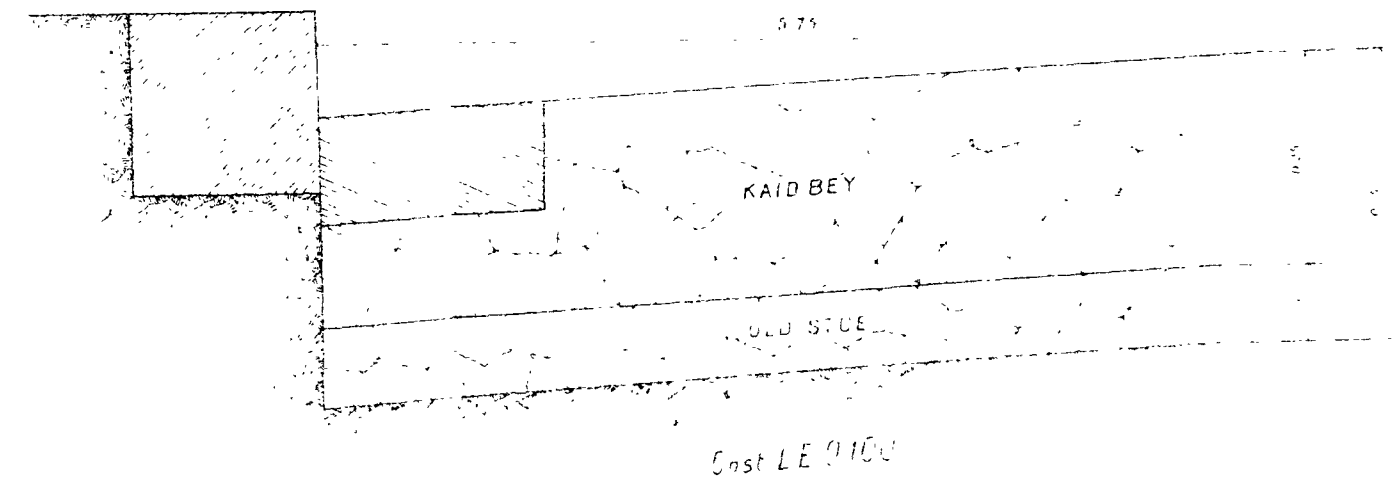
OLD SYSTEM SOFT LIMESTONE.



BASALT ON LIMESTONE.



KAÏD BEY LIMESTONE (ABANDONED).





# STONE AND SAND QUARRIES.

The quarries which have supplied the road materials are indicated in the following statement:—

Materials extracted.	Rifai.	Kaied Bey	Tourah.	Abbassieh.	Abou Zaabal.	Sand from Abbassieh.
	Cub. met.	Cub. met.	Cub. met.	Cub. met.	Cub. met.	Cub. met.
1897. Stone for road foundation... ..	2,780	—	—	—	—	—
1897. Broken stone and sand ... ..	—	7,200	12,724	533	6,600	8,432
1898. Broken stone and sand ... ..	—	—	5,026	9,795	14,294	9,431
1899. Broken stone and sand ... ..	—	—	3,943	19,010	14,266	11,920
1900. Broken stone and sand ... ..	—	—	2,298	3,349	10,488	7,296
TOTALS ... ..	2,780	7,200	23,991	32,687	45,648	37,709

*Rifai*.—The foundation rocks for the basalt roads (Telford system) came from this quarry.

*Kaied Bey*.—The trial made with this stone in 1897 having proved unsatisfactory it has been abandoned.

*Tourah*.—This quarry belongs to the Prisons Department, who works it. The stone is of an inferior quality.

The decreased supply is also due to the prisoners being taken to Abou Zaabal to work the basalt quarry.

*Abbassieh*.—Supply a fairly hard limestone used for the under layer of the basalt roads and the surface of the 2nd class roads.

*Abou Zaabal*.—This quarry supplies the basalt macadam of excellent quality.

*Abbassieh sand*.—After many experiments this sand has given the best results for road making.

**B. — RAPPORT DES DÉPENSES DE L'ENTRETIEN DE LA VILLE DU CAIRE AVEC LES RECETTES DES DROITS SUR LES PROPRIÉTÉS URBAINES, DEPUIS 1895 A FIN 1900.**

ANNEE	ENTRETIEN DE LA VILLE L.E.	DÉPENSES POUR L'ENTRETIEN			AUGMENTATION PROGRESSIVE	DROITS	
		Eclairage.	Balayage et Arrosage.	Total.		Sur les propriétés urbaines.	Augmentation progressive.
		L.E.	L.E.	L.E.		L.E.	
1895	37,261	20,909	17,577	75,747	—	56,000	—
1896	33,900	20,924	21,044	75,868	× 0·16 %	55,400	en moins 1·07 %
1897	33,650	20,924	22,294	76,868	+ 1·31 %	56,610	+ 2·18 %
1898	34,398	20,924	21,372	76,694	en moins 0·20 %	58,420	+ 3·20 %
1899	Ezbekieh. { 26,826 } { 2,484 }	21,524	26,400	77,234	+ 0·70 %	60,900	+ 4·21 %
1900	Ezbekieh. { 26,826 } { 2,484 }	21,474	26,400	77,184	en moins 0·06 %	63,700	+ 4·60 %

Augmentation totale pendant les six années, depuis 1895 à fin 1900. { Sur l'entretien ... .. 1·90 %  
 C'est-à-dire que l'augmentation des droits à été, par rapport, à l'augmentation du crédit de l'entretien, 7 fois  $\frac{1}{4}$  plus forte. { Sur les droits de propriété ... .. 13·75 %

**C.—TROTTORS.**

Category road.	Curbstone.	WITH TROTTOIRS.			EARTH.			How made.	Rate.*	Ct.
		Length.	Breadth.	Area.	Length.	Breadth.	Area.			
1	—	100,000	5	500,000	—	—	—	Old Macadam 0'10 thick.	2	10,000
2	—	120,000	4.5	540,000	—	—	—	—	2	10,800
3	—	16,170	3	139,410	—	—	—	—	2	2,788
4 } 5 }	—	—	—	—	288,000	2.5	720,000	—	2	14,400
4 } 5 }	Curb.	—	—	—	288,000	—	—	—	24	37,988
										69,120
										107,108

\* Rate if adjoining roads are remade and old Macadam is available.



**D.—REPAIRS OF ROADS BUDGET.**

YEAR.	Repairs saved in following year. (Approximate).	Basalt remodelling roads.	Life.	Percentage of total sum.	Roller repairs.	Life.	Percentage of total sum.	Hand repairs.	Life.	Percentage of total sum.	Total spent.
	£E.	£E.	1 Years.		£E.	2 Years.		£E.	3 Years.		£E.
1894	—	—	3	—	1013	$\frac{1}{2}$	$9\frac{1}{2}$	9591	$\frac{1}{4}$	$90\frac{1}{2}$	10604
1895	—	—	3	—	5377	$\frac{1}{2}$	44	6812	$\frac{1}{4}$	56	12189
1896	—	—	3	—	12166	$\frac{1}{2}$	81	2856	$\frac{1}{4}$	19	15022
1897	435	6715	3	47	4807	$\frac{1}{2}$	34	2565	$\frac{1}{4}$	19	14087
1898	—	7260	—	44	6097	—	37	2999	—	19	16356
1899	—	5436	—	41	5767	—	43	2190	—	16	13493
1900	—	3384	—	37	3631	—	39	2165	—	24	{ 9180 4000 }

\* Steam rollers and plant.

E.—STATEMENT SHOWING FUNDS REQUIRED TO CONSTRUCT AND MAINTAIN CAIRO ROADS AND TROTTOIRS (TOTAL AREA).

(Refers to Basalt Macadam only.)

CATEGORY (ROADS' ORDER OF IMPORTANCE OR WEIGHT OF TRAFFIC).	Total Area. SQ. M.	Area at present main- tained. SQ. M.	Difference. SQ. M.	Minimum cost of construc- tion without trottoirs at 160 mills. £E.	Minimum cost of annual main- tenance at 10 mills. £E.	Cost of annual watering and scavenging £E.	First cost scavenging and watering plant. £E.	First cost steam roller plant. £E.	No. of years required to com- plete work.	Wood.	
										Cost of wood con- struc- tion. £E.	Main- tenance. £E.
1st. Category ... ..	550000	385000	165000	26400	6500	2970	22633	14400	8	162000	—
2nd " ... ..	596000	—	596000	95360	23840	10728	—	—	—	500640	—
3rd " ... ..	162630	—	162630	26016	6501	2934	—	—	—	136584	—
4th " ... ..	241370	—	241370	38624	9656	4338	—	—	—	202440	—
5th and 6th Category ...	1150000	—	1150000	184000	46000	20700	—	—	—	965000	—
Total... ..	* 2700000	385000	2315000	370400	92500	41670	22633	14400	8	2267644	226760

RECAPITULATION.

Total first cost for whole area ... ..	{ Roads ... ..	{ Trottoirs ... ..	£E. 370400
Total annual maintenance including scavenging and watering ... ..	{ Roads ... ..	{ Trottoirs ... ..	107108
Total cost purchase plant ... ..	{ Roads ... ..	{ Trottoirs ... ..	134270
	{ Scavenging and watering... ..	{ Rollers ... ..	23120
			22633
			14400
	Total ... ..		671561

\* In 1900, 2781741 M<sup>2</sup>.

TABLEAU DES COEFFICIENTS.

DESCRIPTION	ENTRETIEN PAR CANTONNIERS				RECHARGEMENTS GÉNÉRAUX ROULEAU A VAPTEUR				RECHARGEMENTS GÉNÉRAUX ROULEAU A VAPTEUR				NOUVELLES ROUTES EN BASALTE SANS BLOCCAGE			
	1896-97	1898	1899	1900	1896-97	1898	1899	1900	1896-97	1898	1899	1900	1896-97	1898	1899	1900
1. Épaisseur de pierre par mètre carré. ...	0,638	0,029	0,029	0,031	0,066	0,080	0,086	0,046	0,127	0,145	0,069	0,102	0,130	0,135	0,187	0,109
2. Proportion sable par mètre cube de pierre ...	0,250	0,270	0,263	0,275	0,279	0,272	0,217	0,409	0,220	0,173	0,336	0,208	0,216	0,252	0,261	0,214
3. Cube d'eau par mètre cube de pierre. ...	0,112	0,117	0,391	0,382	0,716	0,572	0,175	1,532	0,305	0,321	0,510	0,431	0,437	0,523	0,135	0,569
4. Cube d'eau par mètre carré de chaussée...	0,017	0,012	0,011	0,012	0,018	0,016	0,041	0,070	0,038	0,017	0,037	0,011	0,058	0,070	0,000	0,062
5. Surface moyenne par journée d'ouvrier.	9,53	19,92	20,85	19,87	12,31	13,61	14,38	18,47	6,55	8,47	13,78	11,39	5,57	1,78	5,66	5,85
6. Surface arrosée par journée de sakka ...	41,26	106,92	116,23	99,11	63,50	80,00	135,89	118,97	318,46	211,85	274,23	206,33	119,41	116,73	119,80	150,40
7. Cube moyen transport par journée tomber.	2,950	3,028	2,816	1,973	5,033	4,203	3,018	5,816	5,424	5,699	3,110	5,079	3,361	1,200	3,677	1,983
8. Chemin parcouru par tombereau p. voyage	1,068	3,963	4,216	6,082	2,100	2,855	3,712	2,053	2,133	2,106	3,519	2,361	3,566	2,857	3,263	6,051
9. Prix de revient des matériaux par m <sup>2</sup> ...	0,0099	0,0077	0,0018	0,0050	—	—	—	—	—	—	—	—	0,0151	0,017	0,0396	0,0352
10. Prix de cantonniers par mètre carré. ...	0,0054	0,0025	0,0025	0,0025	—	—	—	—	—	—	—	—	0,0086	0,0116	0,0096	0,0095
11. Prix de sakka par mètre carré ...	0,0011	0,0005	0,0004	0,0007	—	—	—	—	—	—	—	—	0,0011	0,0015	0,0013	0,0013
12. Prix de tombereau par mètre carré ...	0,0016	0,0015	0,0016	0,0021	—	—	—	—	—	—	—	—	0,0028	0,0080	0,0116	0,0080
13. Prix moyen de revient total ...	0,0183	0,0122	0,0033	0,0106	—	—	—	—	—	{ frais } { divers }	—	—	0,0033	0,0009	0,0015	0,0012
14. Surface moyenne cylindree journ. roul...	—	—	—	—	131,01	129,78	122,63	202,25	351,83	31,072	318,91	281,61	320	290,80	296,18	295,87
15. Prix moyen de cylindrage... ..	—	—	—	—	0,0026	0,0027	0,0027	0,0022	0,0007	0,0019	0,0038	0,0058	0,0058	0,0068	0,0065	0,0073
16. Prix total de rechargement. ... ..	—	—	—	—	0,020	0,026	0,029	0,015	0,013	0,061	0,036	0,033	0,067	0,076	0,0701	0,0625

ROUTES FAUBOURGS, VILLE DU CAIRE.

	LONGUEUR.	SURFACE
	Mètres lin.	Mètres carrés
Route Choubrah, de la place de la Gare jusqu'au Palais de Choubrah ... ..	5453	59239
Routes Koubbeh — Matarieh — Zeitoun, jusqu'à l'Obélisque ... ..	5728	34687
Route Mastouroud, depuis la route Matarieh jusqu'au ponceau ... ..	776	3701
Routes autour et dans le Palais de Son Altesse à Koubbeh ... ..	2932	17152
Route Polygone (Abbassieh) ... ..	2273	22814
Routes depotoirs et carrières (Abbassieh) ... ..	2652	17803
Route Boulac Dacrour... ..	2252	18767
Routes Guiseh — Guesireh et Pyramides ... ..	22882	199198
Total... ..	44948	373361

VI.—GARDENS.

EZBEKIEH GARDENS.

The total gate receipts for the year were £E.1322.080 against £E.1300 in 1899.

The following expenses were met out of this sum :—

	£E.	Mill.
Salaries of collectors, keepers, etc. ... ..	305	040
Cost of uniforms for the keepers ... ..	14	027
English military music ... ..	146	250
Remainder of the indemnity paid to Egyptian Military Band.	15	610
Latrines ... ..	165	672
Garantee green-house ... ..	35	000
Small works... ..	37	303
Vidange of latrines ... ..	18	636
Sundry expenses... ..	43	805
Total... ..	£E.781	343
Balance brought to 1901 ... ..	540	737
	£E.1,322	080
The regular Budget for the garden Service is ... ..	2,484	000
	£E.	Mill.
Out of this is paid for water ... ..	775	251
Gas ... ..	499	008
Egyptian Band ... ..	326	695
	£E.1,600	954

Leaving a sum of £E.774.192 for payment of garden staff, labour and £E.108.854 for repairs, seeds, general stores, etc., etc.

Out of the 30 men and boys employed in the garden it is estimated that 8 men at least, representing £E.150 per annum, are kept to repair the continual damage caused by the fêtes held in the garden, notwithstanding the great trouble taken to keep the garden in good condition.

It is impossible to prevent the large grass plots from being worn into bare patches, especially under the large tents. This is more noticeable after any fêtes held in winter.

I would suggest that the new garden at Ghezireh between the Kasr-el-Nil and English bridges be used for these fêtes. It is larger than the Ezbekieh and enjoys peculiar advantages, such as unlimited funds for upkeep and the magnificent Zohria nurseries as feeders.

As no one is allowed to walk in these gardens, damage to the grass occasioned upon fête days would not be noticed.

COMPARISON OF GATE-MONEY RECEIPTS OF THE ESBEKIEH GARDEN  
FROM 1896 TO 1900.

MONTHS.	1896		1897		1898		1899		1900	
	£E.	Mill.	£E.	Mill.	£E.	Mill.	£E.	Mill.	£E.	Mill.
January ... ..	63	926	17	590	70	626	56	698	67	394
February ... ..			21	610	129	308	116	989	88	736
March ... ..			26	440	95	486	77	876	117	212
April ... ..	27	650	28	970	98	839	102	184	137	449
May ... ..	19	175	31	290	137	800	176	018	167	219
June ... ..	18	715	42	190	152	171	153	638	170	465
1st Half-year ...	129	466	168	090	684	330	683	403	748	475
July ... ..	19	530	34	635	142	391	131	260	124	427
August ... ..	39	490	27	185	105	086	128	134	110	221
September ... ..	32	425	18	755	112	995	123	328	119	057
October ... ..	20	385	18	305	79	971	97	381	81	666
November ... ..	12	535	16	705	70	105	68	893	76	298
December ... ..	16	835	24	200	60	172	61	488	61	936
2nd Half-year ...	141	200	139	785	570	720	610	484	573	605
Total... ..	270	666	307	875	1255	050	1293	887	1322	080
	—		Increase: 13·75%		More than quadrupled.		Increase: 3·08%		Increase: 2·16%	

#### THE GHIZEH NURSERY AND BOULEVARDS.

This work was taken over by Mr. Curtis in April, 1900. The nursery now contains 18 feddans—8 feddans only were under cultivation up to April. During last summer 4,500 Lebaks and other trees were planted on an area of about 5 feddans. Five feddans have been prepared for planting in March.

6,000 cubic metres of filling up and levelling have been executed.

A barbed wire fence has been erected round the whole ground of a total length of 770 metres. On the side of the nursery facing the main road, the old stables and walls have been demolished and a new ornamental railing with W.I. gates 135 lin. metres long has been erected, with a strip of garden and grass plot the whole length of the railing.

A new shed for seedlings 40 metres × 10 metres has been made in a central part of the nursery.

The road to the new Scavenging and Watering Service stables running through the middle of the nursery has been removed and a new road with iron entrance gates made, running parallel to the Wakfs canal and forming the west boundary of the nursery.

A good Kiosk has been made for the use of the Bowab who is on duty day and night.

2,650 square metres of roads have been macadamized, leaving about 4,000 square metres to be done to complete the whole garden. This work is now being pushed forward.

#### BOULEVARDS, SECTION NO. IV.

All the “Labbakhs” on this section are old and many of them in a dangerous state. To lessen the area of wind pressure and in consequence the danger, I have had the trees trimmed very heavily: spoiling (as I have been told frequently) the artistic effect, but this cannot be helped. After the late severe gales I inspected the trees. Forty-eight trees I have marked for removal. Some of these, removed lately, have only one or two main roots left.

In the Ghizeh nursery there are only 200 trees fit for transplanting; these will be put in at Ghezirch in March. For the others we shall have to wait at least three years.

#### GARDENS AND PLANTATIONS.

##### *Watering Trees.*

	1898	1899	1900
No. trees watered ... ..	106,353	99,817	95,556
Volume of water per tree per annum ... .. Cub. met.	0.464	0.475	0.514
Cost per tree per annum in mill. ... ..	7—	8.2	8.5

These figures show no great change.

##### *Trimming, planting and transplanting.*

	1898	1899	1900
No. of trees treated ... ..	22,068	27,675	6,398
Cost per tree per annum in mill. ... ..	37.8	32.2	114.9

This increased cost is due to the trees treated being all of big size. In 1898 the trimmings of 22,000 average sized trees were taken away by 792 carts, it required 880 carts to take away the trimmings of 6,398 big trees treated this year.

*Gardens, Squares and Nursery Gardens* (Except Gizeh).—Of £E.1870 spent on these in 1900, £E.687 were spent on water, £E.232 on purchase of plants.

The cost of maintaining these gardens, etc., has been—

For water (1·62 cub. met. per sq. met.)...	...	12·9 mill. per sq. met.
For all other expenses (mean of 3 years) ...	...	13·3 mill. ..
Total... ..	...	26·2 mill. per sq. met.

The area of these gardens, etc., is 99,178 sq. met. The cost of water for 46,178 sq. met. is not included in the above total expenditure but is allowed for in establishing the rate per sq. met.

This cost should be considered side by side with the value of the plants reared in and sold from the nurseries.

During 1898, 1899 and 1900, 30,874 trees and plants were sold for £E.568 or 18 milliemes each.

During these years 368,763 trees and plants were reared, say worth 5 milliemes each. This gives £E.2,412 as the value of the trees and plants sold or existing in the gardens.

Exclusive of water, £E.3,950 was spent in 3 years on these gardens; deducting the value of the produce, £E.2,412, the cost of maintenance comes to 5 milliemes per sq. met. instead of 13·3 milliemes as given above.

## VII.—CAIRO TRAMWAYS.

(JULY 1ST, 1899, TO JUNE 30TH, 1900.)

The section of Pyramid line between Bahr el Aama and the Pyramids was opened to traffic on 27th September, 1899, and on the 1st August, 1900, the whole line was in working order as far as the Kasr el Nil Bridge. At the point where the tramway crosses the Upper Egypt main line, the level crossing proved unsatisfactory. In consequence the Tramway Company agreed to contribute £E.1,300 towards the cost of construction of an overhead crossing.

During the current year the Khalig line was finished, with the exception of the Helouan railway and Ain Sira crossing, and the line was opened as far as Saidia Zenab on the 5th June.

The modifications of the line at Attaba el Hadra have also been completed.

Some new cars have been added to the rolling stock, most of which are provided with first class and ladies' accommodation. The existing motor cars have also been provided with Hareem compartments.

A new tariff was introduced on January 17th with a uniform charge of 5 mill. for 2nd and 10 mill. for 1st class passengers on each section. The whole system is divided into six sections. The Pyramid line, however, is not subject to this tariff.

In order to ensure the maintenance of a sufficient interval between successive trains, stations have been placed every 250 metres along the line. At some of these stations cars are bound to stop, at others only when passengers are waiting. With a similar view the Company has laid a double line along the Abassieh road and lengthened the sidings on the Old Cairo line.

STATISTICS. TRAMWAY. PERIOD JUNE 30TH 1899-JUNE 30TH 1900.

	June 30th 1899	June 30th 1900
<b>I.—GENERALITIES.</b>		
Number of years concession... ..	50	
Expiration in year ... ..	1946	
<b>II.—TRAFFIC.</b>		
Total number passengers... ..	9,856,699	11,215,960
Mean daily number of passengers... ..	27,003	30,811
Mean in p.c. of population Cairo... ..	4.75	5.45
Trains multiplied by kilometres ... ..	1,902,234	2,294,927
<b>III.—FINANCIAL DATA.</b>		
Capital ... .. Fcs.	6,000,000	
Gross revenue ... ..	1,355,986.79	1,498,945.69
Total cost (indemnity for accidents not included ... ..	759,005.24	804,936.19
Costs in p.c. of revenue ... ..	56	53.7
Interest on shares ... ..	7.66	7.66
Distributed to Administrators ... .. Fcs.	—	48,101.79
Balance available for distribution to share holders... ..	460,000	460,000
Sum carried to Reserve... ..	27,243.89	26,723.22
Gross revenue per car and kilometre... ..	0.712	0.653
<b>IV.—LINE &amp; CARS.</b>		
Length of single track line in metres... ..	6,522	14,783
Length double track line in metres ... ..	16,212	20,854
Total length of line in metres ... ..	22,734	35,637
Number of motor cars ... ..	83	94
Number of trailers ... ..	59	59

The figures concerning the generating plant are still the same as those given in last year's report.



# VIII.—SCAVENGING WATERING.

As in 1899,  $\frac{1,708,545}{2,781,742} = 61\%$  of the total area of Cairo is swept and watered twice a day in a perfunctory manner. With the present budgetary allowance only 50% can be well cared for. As the inhabitants cannot be prevented from throwing into the streets at all times of the day rubbish which, added to the street detritus, amounts to 1,025 cub. met. or 789 tons per day (see Table I), the roads to the casual observer appear not to be cleaned at all. For purposes of experiment an area of 8,000 sq. met., say  $1\frac{1}{2}$  kilometres length of street, was watched by special Inspectors. The following amount of water and rubbish was thrown out in 24 hours:—

624 pails of slop water.  
337 litres night soil.  
373 baskets refuse.  
51 tins ashes.

The number of tons of rubbish which, with the transport at our disposal, are daily carted out of Cairo amounts to 320.

During my absence in Europe, an additional grant of £E.250 per month was allotted to this Service for the purpose of removing rubbish from the native quarters once in four days. This is of course only a palliative.

The credit required to clean and water 1,708,545 sq. met. consisting of paved and earth streets =  $1,708,545 \text{ sq. met.} \times \text{£E.17.5} = \text{£E.29,899}$ .

To clean the remaining 1,073,197 sq. met. (which do not need watering) a higher coefficient is required to compensate for the narrowness of the streets and the difficulties of communication with the main thoroughfares. We therefore take 1,073,000 sq. metres  $\times \text{£E.9} = \text{£E.9,657}$ .

The total sum required is thus:           £E.

29,899
<u>9,657</u>
39,556

of which only £E.25,858 is allowed.

The price of labour is rising in Cairo, and it is possible that the present coefficient per 0/00 metres may have to be increased.

All rolling stock is built and repaired at the Government Arsenal.

Stores and materials are for the most part obtained from England. In addition to their better quality and great durability, they are generally cheaper than what can be obtained locally.

Thanks to Mr. Fitzpatrick, a very large economy has been made on forage by the introduction of a better system of weighing and measuring.

At the close of 1899 an English platform weighing machine of a capacity of 2 tons, and graduated in English and metrical weights, was introduced at Kasr-el-Nil stables for weighing supplies and issues of forage. A crate capable of holding 7 cubic metres was fitted to take berseem, straw, etc.

The result has proved very satisfactory and shows an economy of 15% in comparison with the old method of receiving and issuing by measures.

An elaborate system is in vogue to ensure the correctness of the weight supplied by the Contractors.

The metrical system of weights is generally adopted throughout the Service.

The following tables show the old and new scales of forage issues for working animals daily :—

TABLE I.

OLD SCALE ACCORDING TO MEASURES.

ANIMALS.	Barley.	Beans.	Bran.	Tibbin.	Straw.	REMARKS.
	Kadahs.	Kadahs.	Rottls.	Oks.	Kilos.	
1 Horse ...	4	Nil.	2	3	2	
1 Mule ...	4	1	1	3	1½	
1 Ox ...	Nil.	4	Nil.	8	1½	
1 Donkey ...	Nil.	2	Nil.	3	1½	

TABLE II.

NEW SCALE BY WEIGHT.

ANIMALS.	Barley.	Beans.	Bran.	Tibbin.	Straw.	REMARKS.
	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.	
1 Horse ...	4½	Nil.	9 10	3½	2	In season Berseem and Dourah are issued at the rate of ½ kantar per animal, the bran being discontinued.
1 Mule ...	4½	1½	½	3½	1½	
1 Ox ...	Nil.	5	Nil.	9½	1½	
1 Donkey ...	Nil.	2½	Nil.	3½	1½	

TABLE III.

COST OF FORAGE PER ANIMAL.

ANIMALS.	Daily.	Weekly.	Monthly.		Yearly.		REMARKS.
	Mill.	Mill.	£ E.	Mill.	£ E.	Mill.	
1 Horse ... ..	40	280	1	200	14	600	In 1900 the prices of forage have been abnormally high.
1 Mule ... ..	45	315	1	350	16	425	
1 Donkey ... ..	26	183	—	786	9	563	
1 Ox ... ..	56	392	1	680	20	440	

*Animals and Stabling.*

We have now 424 animals at work. The price of mules has steadily risen. Outside prices for small mules stand at from £E.25 to 30, the same class of mule a few years ago being valued at about £E.17. The suppliers at Alexandria quoted this season for the large Greek mules used in our double water-carts £E.40 per head. There is great difficulty in buying good animals in the country as, owing to the increase of value, big contractors are not now willing to sell their animals in the slack season as formerly.

The stables, with their distances from the centre of the city, accommodation, areas, and positions, are shown below.

STABLES.	Distance from Post-Office.	Accommodation for animals.	Stabling area.	Area per animal.	REMARKS.
	Kilometres	No.	M <sup>2</sup>	M <sup>2</sup>	
Kasr-el-Nil ...	1½	199	1,393	7	Feed the centre of City.
Boulac ... ..	1½	79	546	—	" " "
Abbassieh ... ..	3½	100	700	—	Feed Abbassieh.
Shoubra ... ..	3¼	14	98	—	Shoubra and Old Cairo Stables are lent to the Service by the Police in return for the use of our water-carts in case of fire.
Old Cairo ... ..	5¼	5	35	—	
Ghizeh ... ..	4¼	35	245	—	Ghizeh, Ghizereh, etc.

*Baths.*

Intermittent and impotent efforts are still made to prevent the owners of baths from intercepting our carts and purchasing their

contents from the drivers for fuel. I myself consider that the baths act as destructors of moderate efficiency and, seeing that we would be quite unable to remove with service carts much of the detritus now gathered and burnt without cost to the State, I am of opinion that the practice should be regulated and organized, but not suppressed.

By experiment on eight baths an average of  $4\frac{1}{2}$  cubic metres of rubbish is furnished to each per day.

If we assume that each of the fifty-six baths burns only 3 cubic metres per day, we arrive at cubic metres 168 as the total amount of rubbish burnt daily without expense to Government.

#### *Destruction of Rubbish.*

To scientifically consume a similar amount at 9 tons per cell per day would necessitate the erection of an eighteen cell Destructor costing:—

$$£E.18 \times 400 = £E.7200 \text{ at least.}$$

The cost of burning per ton is about P.T. 5 in Europe or say for the above cube:

$$168 \times 5 = 840 \text{ P.T. per day}$$

or £E.3.066 per annum.

The following is an estimate of an English Destructor:

*Manlove Alliot and Co.'s*—For a town of 40,000 to 50,000 inhabitants it is estimated that a plant would have to provide for the disposal of 12,000 to 14,000 tons of *Ashbin Refuse* per annum (=0.28 tons per head per annum).

The approximate cost of erection of the plant in England—

	£E.
Eight cells consisting of brick and iron work on ordinary foundations, and suitable for low grade refuse.. ...	2,000
Automatic charging apparatus.. ... 700 to 800	
Tipping platform and inclined roadway depending upon site	1,500
Multitubular Boiler for absorbing the waste heat, placed on the main flue, sufficient to provide steam for lighting the works electrically and probably drive Mortar Mills..	300
	<hr/> £E.4,600

For this plant a chimney would be required about 150 feet high, and having a minimum flue area of 20 square feet.

On the above basis an installation to consume the detritus of Cairo (570,000 inhabitants) would cost £E.65,550.

#### *Rain.*

In February, the Service worked four days and nights continuously to remove 12,528 tons of slush resulting from one day's heavy rainfall. A scheme is being prepared for surface drainage.

The effect of a severe rainfall can only be gauged by actual figures. The rainfall of 25-26 January of this year was one of the heaviest on record.

The Service worked continuously five days and nights in order to render traffic possible.

12,600 carts water were removed.

4,030 „ slush and mud.

382 „ sand were used.

It is impossible at such times to work in the native quarters, as the streets are converted into a bog and are impassable for our animals and carts. Unless the actual street surface to the depth of perhaps a foot could be carted away wholesale, there is no means of remedying this terrible state of affairs, but this course is, obviously, an impossibility.

The wear and tear on animals and material during rain work is very high. The animals for a long time show the effects of the extra work. During rain work the animals receive  $\frac{1}{4}$  extra rations daily.

The water-carts especially require a great amount of extra repair to render them capable of taking up their ordinary work. The pipes become quite choked, and a deposit of sand and mud which hardens like cement forms at the bottom of each cart sometimes to the depth of quite 7 centimetres.

A fact that should not be lost sight of is, that in this climate while the Service is pumping an accumulation of rain water from a side street, the ordinary thoroughfares surrounding it may be quite dry and in urgent need of watering. Thus the Service has complaints on one side to remove dirty water and on the other to put down clean water.

To give an idea of the extra expense incurred during rain work I will give an example :

Taking Sharia "Clot Bey," area 7,500 sq. metres.

Normally, this area is kept clean for a daily cost of P.T. 15.

The following labour was found necessary to remove the water and mud and bring the street to anything approaching cleanliness :—

	£E. Mills.
40 Carts... ..	6 640
2 Machine brushes ... ..	460
30 Sweepers ... ..	1 200
Supervision ... ..	830
Total... ..	<u>£E.9 130</u>

A sum which under ordinary circumstances should keep the same area cleaned for **608 days**, or nearly 2 years.

This applies with more or less force throughout the whole city.

Again, during the last rain, in order to accelerate the work it was found necessary to form a dépôt for the mud near the Kasr-el-Nil Stables; 1,222 tons were deposited there and this had to be recarted to Ghizeh, a distance of nearly 5 kilometres, and necessitating the use of over 400 carts: all in addition to the normal work.

### *Detritus.*

Careful experiments in Germany, etc., have led to the establishment of formulæ for computing the amount of road and house detritus produced per unit, shown at Tables II, III, IV at end of report.

They are interesting in view of comparison with Cairo.

### *Divisions and Labour.*

Cairo is divided for conservancy purposes into twelve districts, vide Table V.

A sweeper to clean his normal area walks 18 kilometres a day, or 11 to 12 miles.

A water cart mule walks 32·8 kilos. or 20½ miles.

A dust cart mule walks 35·6 kilos. or 22 miles.

A native Inspector to properly execute his work should bicycle from 16 to 35 kilometres per day.

### *Rubbish Dépôts.*

Our rubbish depots at present are six in number and situated as follows:—

Numbers.	NAME.	Locality.	Distance from Post-office.		REMARKS
			Kilom.	Eng. Miles.	
1	Chamra... ..	Abbassieh on Ismaïlia Canal.	3	1½	Used to supply the rubbish purchased by H. H. the Khedive and Boghos Pasha Nubar.
2	Chanaouani ... ..	Outside, east of City.	2	1½	With very bad road strains mules and carts heavily.
3	Souk-el-Goma ... ..	Outside, S. of City.	3.2	2½	Too far from town for general use.
4	Ghizeh ... ..	Govern. Gardens.	5	3½	Temporary filling up buckets.
5	Abattoir... ..	Old Cairo.	3.3	2½	Newly pointed out by Sanitary Department.
6	Bab-el-Huseinyeh.	Abbassieh.	2.6	1½	Bad road very little used.

It frequently happens that we are prevented from using dépôts which appear admirable from all but the hygienic stand-point.

The tendency to remove our depôts further and further from the city naturally correspondingly lessens our daily output.

This diminution must be calculated not in the ratio of the distance only but in that of the enormously increased haulage on unmade roads.

The latter ratio I may remind you is 7 to 1.

If at any time a light railway were laid in Ghizeh Province, arrangements for transporting and utilizing this rubbish could no doubt be made.

TABLE I.

### ESTIMATE OF DAILY AMOUNT OF RUBBISH IN CAIRO.

1 Cart load holds	... ..	0·88 cub. met.
1 Cart load weighs	... ..	675 kilos.
1 Cubic metre weighs	... ..	0·768 tons.

A.—*Normal Collection Daily.*

Normally 87 carts work daily in main streets, of which 60 collect 3 loads each daily and 27 collect 5 loads each daily; 45 carts work in  $\frac{1}{4}$  of lanes (1 cleaning every 4 days) and collect 3 loads each.

$$\text{Thus: } \left. \begin{array}{l} 60 \times 3 \\ 27 \times 5 \\ 45 \times 3 \end{array} \right\} = 450 \text{ loads daily.}$$

Rain work gives 805 loads per day or 355 in excess of normal.  
We work 25 days rain work

$$\therefore \frac{355 \times 25}{315} = 28 \text{ loads extra daily.}$$

150 - 24 = 126 loads	average daily	} which can be removed with present means of transport.
174 x 0.88 = 153 cub. met.	" "	
174 x 0.75 = 130 tons	" "	

B.—*Native Quarters Collection.*

As 45 carts only clean  $\frac{1}{4}$  of native quarters the actual rubbish still in lanes would be :—

Cuts = loads  
 $45 \times 3 \times 3 = 405$  loads,  
 or = 356 cub. met.,  
 or = 273 tons (daily output untouched).

C.—*Native Baths Collection.*

Synative baths collected a total of 36 cub. met. daily. Cairo has 56 baths

$$\therefore \frac{56 \times 36}{8} = 252 \text{ cub. met. total taken daily by baths, or}$$

D.—*Total.*

A	gives daily normal collection as..	...	417	cub. met.
B	" " remnant in native quarters.	...	356	"
C	" " collection by baths	...	252	"

Daily total ... .. 1025 cub. met. = 789 tons.

Annual total { 374,125 cub. met. } approximate.  
{ 287,985 tons. }

TABLE II.

MEAN CUBIC METRES DETRITUS PER ANNUM.

TOWNS.	Street refuse.		House refuse per Head per annum.	Total per Head per annum.	REMARKS
	Per lin. met. per annum.	Per Head per annum.			
	Mean.	Mean.	Mean.		
Paris ... ..	0.49	0.25	0.35	0.57	Population, Cairo = 570,000. This average gives per head for Cairo — 570,000 × 0.57 = 890 cub. met. daily and 321,900 cub. met. per annum, or 249,213 tons.
London ... ..					
Amsterdam ... ..					
Baltimore ... ..					
Berlin ... ..					
Boston ... ..					
Bremen ... ..					
Frankfort ... ..					
Haag ... ..					
Hanover ... ..					
Karlsruhe ... ..					
Cologne ... ..					
Copenhagen ... ..					
Lüttich ... ..					
Manchester ... ..					
New York ... ..					
Philadelphia ... ..					
Rome ... ..					
Rotterdam ... ..					
Stuttgart ... ..					
Vienna ... ..					
Cairo ... ..	0.52	0.49	0.16	0.65	570,000 × 0.65 = 1,020 cub. met. daily or 783 tons and 372,300 cub. met. per ann. or 285,795 tons approx. There being no house-to-house collection, the greater part of house refuse is ejected into the streets and thus is included as street refuse.



TABLE III.

GROSS COST FOR EACH TIME CLEANING 1,000 SQ. MET. MACADAM.

TOWNS.	Condition of road.	Cubic metres removed in month.	Gross Cost in mill.	REMARKS.
Liverpool ... ..	Good... ..	15 $\frac{3}{4}$	84	—
" ... ..	Bad ... ..	38 $\frac{1}{2}$	168	—
Cairo ... ..	Good... ..	15	60	Sharia Magraby.
" .. ...	Bad ... ..	40	156	Sharia Sikket-el-Guedidah.

TABLE IV.

ANNUAL COST IN MILLIEMES FOR CLEARANCE OF DETRITUS.

TOWNS.	Street detritus only.		House refuse only, per Head.	Street refuse only, per Head.	REMARKS.
	Per Head.	Per sq. met.			
Hamburg .. ...	25	2 $\frac{1}{2}$	22	47	
Mayence... ..	25	—	—	—	
Berlin ... ..	60	20	—	—	
Hanover... ..	45	—	—	—	
Paris.. ...	—	15	—	—	
Vienna ... ..	—	16	—	—	
London ... ..	—	15	—	—	
New York ... ..	—	12	—	—	
Mean, England ... ..	—	25	—	—	
Karlsruhe ... ..	—	—	21	—	
Average of the 10 towns.	38·8	15	—	—	
Cairo.. ...	22·5	7·5	—	—	House refuse cleared by Service with street detritus.

TABLE V.

TABLE SHOWING AREA, LENGTH, AND DIVISIONS OF INSPECTION.

Section.	Area. sq. met.	Length metres.	Supervision	Inspection.	General Inspection	REMARKS.
1	293,366	32,868	1 Shawish.	1 Sub-Inspector.	Chief of Service.	Including country roads to Koubbeh.
2	23,416	3,715	..			East of city.
3	90,915	6,560	..			Ezbekieh quarter
4	111,827	13,444	..			Quarters east of Sharia Mahomet Ali up to Citadel.
5	228,179	19,816	..	1 Sub-Inspector.		Quarters west of Sharia Mahomet Ali, including Abdin District
6	217,365	22,759	..			Ismailia quarter.
7	142,843	14,136	..			Kasr-el-Doubara and Bab-el-Louk.
8	88,400	10,743	..			West of Citadel
9	79,567	8,376	..	1 Sub-Inspector.		Old Cairo
10	119,602	11,836	..			Shoubra
11	72,966	8,490	..			Boulaq.
12	240,099	32,348	..			Includes Ghizeh & Ghizeh roads up to Pyramids.
Totals.	1,708,545 or 407 fedd. or 392 acres.	184,991 or 185 kilom. or 116 miles.	These figures refer only to the area at present cleaned and watered the native quarters are not included.			

## IX.—GAS INSPECTION REPORT, 1900.

There are 3,171 gas lamps in Cairo, or about a quarter the number required to light the whole City.

The cost of the 3,171 lamps is, approximately, £E.20,640. 475 lamps extra are urgently required. An extra credit of £E.3,092 should be granted for this.

The terms of the concession bind the Government to accept the standard of illumination and consumption which obtained in Paris in the year 1873.

We are thus debarred from benefitting by the advantage of the Auer system. An Auer burner consumes 106 litres per hour against 140 specified in the contract. A clause in the concession which was evidently originally framed to enable Government to profit by the development of the gas-saving appliances proves to have been mutilated in transcription: (compare Art. 17 of 15-2-1865 and Article 25 of 17-12-1873).

ARTICLE 17.—“ Si le progrès des sciences faisait découvrir un mode  
 “ de fabrication nouvelle plus économique *du gaz* et consacré par une  
 “ pratique de cinq années en Europe, M. Lebon devra l’employer et  
 “ faire profiter le Gouvernement de la moitié de l’économie résultant  
 “ pour lui de la nouvelle découverte, sans que la présente clause puisse  
 “ innover ni déroger à l’article 6 du présent.”

ARTICLE 25.—“ Si le progrès des sciences faisait découvrir un mode  
 “ de fabrication nouvelle plus économique *que le gaz* et consacré par  
 “ une pratique de deux années en Europe, M. Lebon devra l’employer  
 “ et faire profiter le Gouvernement de la moitié de l’économie résultant  
 “ pour lui de la nouvelle découverte, sans que la présente clause puisse  
 “ rien innover qui déroge à l’article 7 des présentes.”

The Finance Department proposed, and the Company accepted an interpretation by which the latter were “compelled” to erect an Electric Light installation.

While benefitting the wealthy and leisured classes, this compact in no way advances the question of public lighting. Negotiations were started with the Company with a view of increasing the number of public lamps in the ratio of the Auer system, that is as approximately 140 to 106. The Government would in this manner have been enabled to erect nearly 25% more lamps without increasing their gas bill. The Company maintained their right to charge for 140 litres though only 106 were burnt. The negotiations thus fell through.

While the Town Lighting Service was under the supervision of the Government, the latter adopted a time-table which was at variance with the terms of the concession. This was prejudicial to the Treasury and of no utility to the Public.

At the beginning of 1900 our Department pointed out this irregularity and, after agreement with the Company, a new system was adopted from the 16th March, 1900.

This system gives an average economy of 33 minutes per night and per lamp, or the large economy of £E.675 per annum, thus:—

33 min.  $\times$  365  $\times$  1586 lamps = 17511 francs or £E.675.648 Mill.

Deducting fines the total cost of supervision per 100 lamps has been reduced to £E.7.8 against £E.13.6 in 1897.

# GAS INSPECTION, 1900.

TABLE OF COMPARISON OF EXPENSES BETWEEN THE YEARS 1896 TO 1900.

YEARS.	Number of lamps.	Cost of employees.	Inspection Shawishes.	Carriage hire.	Lamps displaced at the expense of the service.	Repairs to bicycles.	Purchase of new bicycles.	Total.	Fines inflicted.	Net cost of inspection.	Net cost per 100 lamps.
		£E.	£E.	£E.	£E.	£E.	£E.	£E.	£E.	£E.	£E.
1896	3,075	360	60	60	75	nil	nil	495	2	493	15.90
1897	3,075	360	60	60	79	"	"	499	nil	499	16.09
1898	3,075	360	36	36	38	"	"	434	"	434	14.00
1899	3,171	396	nil	nil	29	10	65	635	258	377	11.78
1900	3,171	396	2	2	41	13	13	573	283	290	9.00

## Remarks.

- (1) In 1900, for eight months only, 44,000 lamps were reported as giving bad light, whereas during the whole of 1900 only 25,000 lamps, or 67 % less were reported: a fact which speaks for the improvement effected in the public lighting.
- (2) In 1900, the Inspection Shawishes were reduced in number from 4 to 3, thus economising £E.36 to the service.
- (3) In 1900 the cost of lamps displaced is greater than the preceding year on account of the removal of plants rendered necessary by Tanzim work, the full cost therefore being borne by the Service.
- (4) In 1899 the fines against the Company were from the month of April only. Fines were inflicted during the whole of 1900.
- (5) On account of the time table used by the Gas Company being at variance with the terms of the Contract, it was corrected with a resultant economy to the Service of £E.67.5 p. a. and without prejudice to the public lighting.

## X.—ELECTRIC LIGHT SUPPLY IN CAIRO.

In the following table are given statistics concerning the electric light supply in Cairo during the past year. The quantity of units sold shows an increase of 37 % over the corresponding figure of the previous year, which is a very remarkable development in so short a

time. The consumption of current is as yet a small one compared to that of European towns of equal population. If the annual production continues to increase in the same proportion, it may be hoped that the profits, which are now nearly nil, may cause the venture to be a remunerative one. The present unfortunate results must be attributed partly to the very variable demand for current in winter and summer and to the fact that expenditure remains nearly constant throughout the whole year. Partly also to the very high price of coal. To meet the increased demand, the underground network had to be extended considerably; 13 kilometres of new cable have been laid under the public streets in the past year.

STATISTICS, ELECTRIC LIGHTING.

	PERIOD.	
	December 31st, 1899.	December 31st, 1900.
I. QUANTITIES.		
Units sold ... ..	221,192	303,413
Units per 8 c. p. lamp connected ... ..	8·84	12·14
8 c. p. lamps connected ... ..	39,382	48,768
Arc lamps connected ... ..	70	95
Maximum daily supply ... ..	336	428
Capacity of plant in kilowatts... ..	800	800
Capacity in 8 c. p. lamps... ..	25,000	25,000
Length of underground cables in metres ...	58,000	71,000
II. CAPITAL.		
Expended (Total)... .. Frs.	1,995,586·21	2,243,301·00
Plant.. ... ..	1,109,535·13	1,128,353·71
Mains and laying ... ..	885,864·08	1,114,760·29
Number of years concession ... ..	30	
III. REVENUE AND EXPENDITURE.		
Total revenue from supply... ..	221,193·67	303,412·59
Total working expenses ... ..	139,953·63	221,755·70
Fuel ... ..	62,780·64	99,366·10
Oil ... ..	4,429·50	1,593·34
Wages ... ..	44,167·02	64,793·09
Maintenance ... ..	6,918·31	17,014·11
Miscellaneous (frais généraux) ... ..	21,658·16	38,989·06
Cost of unit sold ... ..	0·634	0·73
Price of unit ... ..	1·00	1·00
Percentage of total costs to gross revenue ... ..	63·4	73·00
Working profit ... ..	81,240·04	81,656·89
Percentage of working profit to capital expended ... ..	4·07%	3·64%
Carried to sinking fund ... ..	3·33%	3·33%
Net interest ... ..	0·74%	0·31%

## XI.—HELOUAN WATER SERVICE.

The working of this Service throughout the year has been very satisfactory. The machinery, pumps, and pipe system are in good order and condition. There has been no failure in the water supply at any time.

The receipts are £E.240 more than in 1899.

Fifty new Fraeger water metres have been purchased at a cost of £E.201.

Spare parts to the large pump have been procured at a cost of £E.32. These two items are included in the general expenses.

Owing to the low Nile, supplementary pumps had to be erected on the Nile bank. These were working from April to August and entailed an additional outlay for coal and labour of £E.155.990.

On account of the low Nile and the high price of coal, the increase of expenditure over the normal amounted to £E.784.794.

In spite of these adverse circumstances the gross profits equalled £E.877.

# HELOUAN WATER SERVICE.

## RECEIPTS.

	£E. Mill.
Receipts from private consumers for water supplied (115721 cubic metres) ... ..	1787 180
Receipts from Government for water supplied (110775 cubic metres) ... ..	1107 350
Total... ..	£E.2894 530

Normal budget ... .. £E.1232

## EXPENSES.

	£E. Mill.
Salaries ... ..	535 900
Coal and materials ... ..	1370 679
Repairing pipes and tanks ... ..	29 241
Sundries ... ..	80 974
Total expenses ... ..	£E.2016 794
Profit ... ..	877 736

Total... .. £E.2894 530

Normal expenses ... .. £E.1340

## XII.—GHIZEH AND GHEZIREH WATER SERVICE.

This Service has been working well throughout the year.

Owing to the high price of coal a supplementary Credit of £E.1,200 was asked for and granted.

A new pump has been erected to supply the Ghezireh Grotto with high lift water from the chimney tank and is working well.

We have at Ghezireh a very fine pump considerably too powerful for the requirements of the area under command. By removing this pump to Ghizeh and using its spare power in lieu of one of the existing beam engines, an annual saving of £E.400 could be effected on the Budgets. The total cost of removing and re-erecting and arrangement for supplying Ghezireh from the Central Station by a wrought-iron conduit would not cost more than £E.3,500.

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## XIII.—KASR-EL-NIL AND ENGLISH BRIDGES.

The work of controlling the river traffic through the bridge has been efficiently conducted. Several complaints have been received from owners of dahabiehs and launches, but in every case the crews of the boats have been proved to be in fault through not conforming to regulations.

All the guide barges have been thoroughly repaired at a cost of £E.114.

In the summer the work of replating the English Bridge was commenced, but operations were stopped until after the close of the winter season. One-third of the bridge remains to be done.

I hope we shall be able to complete the work this year, as also the changing of all bad plates on the Kasr-el-Nil Bridge.

Both the bridges badly require painting; the last time the bridges were painted was in 1891.

### BENHA BRIDGE.

The work on this bridge throughout the year has been satisfactory. The roadway over the bridge is a great convenience to the general public. The ferry boats have ceased running.

For the third year I have to report that the guide rafts for passing the river traffic have acted perfectly. Not one accident has occurred.

The ironwork of the bridge very badly requires painting.

The amount allowed for working the bridge is £E.360 per annum.

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# REPORT ON THE SURVEY DEPARTMENT

1900

BY

CAPT. H. G. LYONS, R.E.,

*DIRECTOR-GENERAL. SURVEY DEPARTMENT.*



# REPORT ON THE SURVEY DEPARTMENT FOR THE YEAR 1900.

The work of the Survey Department during 1900 has been continued on the same lines as those described in last year's report.

The minor triangulation of the Fayum was completed, and also a considerable proportion of the major triangulation of the provinces of Daqahlia and Qaliubia; while the minor triangulation in these provinces was commenced at three points.

The theodolite traverses which furnish the fixed points for the chain survey were completed in Menufia province where there was no previous triangulation, this being the last of the provinces surveyed without it. The Fayum also was nearly completed by the end of the year. At present this is the part of the Revenue Survey, in which most delay occurs, partly from errors in the work of the surveyors, but more frequently from the stone marks being shifted or wholly removed. This causes often weeks of delay in the survey of a village, and the survey of the Fayum province, where such acts have been specially numerous, is likely to be seriously delayed by it.

The Revenue Survey (including under this head the chain survey on a scale of 1:2500 and the compilation of the Arabic Land Registers) has made very satisfactory progress. The portion remaining of the 780,000 which had been taken over for revision and completion from the Government Lands Department in 1898, have been nearly completed, leaving only a few villages in Tanta and Zifta Merkazes to be done in 1901. This work has been most efficiently done by the 5th Taftish under Ahmed Eff. Tewfiq, with the exception of Merkaz Mehallet-Kubra which was done by Mr. G. W. Fraser.

The work during the past year besides the revision above-mentioned included :—

Merkaz.							Mudiri.
Fua ...	...	...	...	...	...	...	Gharbia.
Sherbin	...	...	...	...	...	...	
Embaba	...	...	...	...	...	...	Giza.
Giza...	...	...	...	...	...	...	"
Ayat	...	...	...	...	...	...	"
Saff...	...	...	...	...	...	...	"
A-shmun	...	...	...	...	...	...	Menutia.

These merkazes were nearly completed during the year, and work was also commenced in Sennuris Merkaz, Fayum.

Nine villages in Merkaz Saff had also to be left until late in the year on account of the lands not having been before cultivated in consequence of the Low Nile. 1899.

A new Taftish was authorized in August, 1900, and was formed gradually during the autumn as soon as the necessary surveyors could be trained, but it was not in full work till the end of the year.

In the course of the year the total area dealt with was as follows:—

Surveyed in the field ... ..	449,540 feddans
Area for which Land Registers were compiled ... ..	972,214 „

but of this latter number 546,000 feddans represent the Revision work for which no new field work was done, and which employed one Taftish for a whole year, and another for nearly six months.

The rate of work both in the field and in the compilation of the registers has also improved, and moreover the proportion of time spent in field work to that spent on the registers is very much more satisfactory.

Average time taken for 1,000 feddans:—

	Field work.	Register.	Total days.
1899	36·5	82	118·5
1900	27	37	64

The transfer of the Survey Department Offices to Giza has enabled a much larger out-turn of work to be achieved than in previous years in consequence of the better accommodation. The greatest pressure has fallen on the Computing Office under Mr. J. I. Craig, assisted by Mr. P. Stadler.

The whole of the computation of the triangulation, and the theodolite traverses as well as the plotting of the points thus determined on the field sheets is done in this office, and the removal of the marking stones already alluded to has caused much delay to the work by necessitating re-computation of many villages.

To this Section has also been added the preparation of the Daily Weather Reports which have been commenced since 1st May, 1900.

As soon as the Abbassia Observatory had been reorganized as mentioned in last year's report, secondary Meteorological Stations were equipped at Port-Said, the Barrage, Assiut, and Assuan. From each of these stations, as well as from Alexandria and Omdurman where sets of instruments already existed, telegrams are despatched at

8.30 a.m. daily reporting the weather, and these messages are corrected and prepared for publication under Mr. Craig's direction.

In addition to the stations above-mentioned, Mr. P. Wakeham, of Beni-Suef, kindly furnishes a weather telegram daily from that station.

The results are lithographed and distributed between noon and 1 p.m. daily. This was commenced from 1st May, 1900. Later on, by the liberality of the Eastern Telegraph Company, who agreed to transmit the daily weather telegrams over their cables free of charge, it was arranged with the Meteorological Services of Malta, Italy, Austria and Greece that daily weather telegrams should be interchanged. By the end of the year this was working, and at 8 a.m. telegrams are now exchanged between Alexandria and Malta, Brindisi, Trieste, Athens and Beirut.

On being received here an abstract of the weather contained in them is telegraphed to the Port Offices at Alexandria and Port-Said, where the telegrams are posted for the information of shipping.

Rain gauges have been established at Tewfiquia, Roscires, Kassala and Suakin, and it is proposed to further equip these stations next year.

In the Drawing and Lithograph Office during the year a very large amount of work has been carried out. The number of map sheets printed and published were as under:—

	No. of map sheets	Total No. of copies.
Village maps ... ..	840	38,025
Other maps, plates for reports, etc. ... ..	34	19,250
Total... ..	874	57,275

The new building for the photographic reproduction of maps was commenced during the year but is not yet completed. Dr. J. Ball remained in Europe for three months studying the methods of photographic reproduction and the equipment which would be most suitable for the conditions of this country and the class of work to be dealt with.

The increase in the sale of maps have been maintained, and the number of applicants wishing to consult the various maps has so increased that a special room had to be built, and an addition made of two clerks to the map Curators Staff.

The sales in 1900 compared with those of the previous years were as follows:—

YEAR.	Printed maps	Tracings	Books	TOTAL.
	£L.	£L.	£L.	£L.
1898	—	—	—	141,500
1899	145,768	139,552	Includ with tracings	285,320
1900	125,821	426,887	15,681	568,389

The whole number of maps and books issued was as follows:—

	Sold	Issued free for Government purposes during 1900.
Printed map sheets ... ..	906	20,453
Books and reports ... ..	103	1,738
Total... ..	1,009	22,181

The total sum expended by the Survey Department was £E.30,256 besides Credits for the Geological Survey of £E.3,014, for forming a 6th Taftish of £E.1,500, and for well-borings of £E.340.

The Geological Staff during the year were principally employed in compiling the results of previous years' field work and preparing them for publication.

During the year there was published:—

A Report on the Phosphates of Egypt.

In the Press are:—

A Report on the Geology and Geography of Kharga Oasis.

.. .. Dakhla Oasis.

.. .. Farafra Oasis.

A Report on the Building Stones of Cairo.

Also the following reports are in preparation, and almost ready for printing:—

On the Geology of Baharia Oasis.

On the 1st Cataract, etc.

On the Geology of the Eastern Desert.

On the Peninsula of Sinai.

On the Fayum, and on the Nile Valley.

A trial boring for water was made at Kafr Dawar, but the result was not sufficiently satisfactory for further boring to be undertaken there.

A Geological Museum was commenced during the year, and will probably be finished during the early part of 1901.

The Laboratory under Mr. A. Lucas has done a great deal of work during 1900, principally for the Geological Staff and for the Tanzim Department.

TABLE I.

YEAR.	Number of samples analysed.	YEAR.	Number of samples analysed.	Increase per cent
1899	122	1900	246	101·6

TABLE II.

FROM		Number of samples analysed.	
		1899	1900
Public Works Ministry ...	( Survey Department ... ..	50	101
	( Tanzim Department ... ..	50	63
	( Irrigation Department ... ..	11	4
	( Department of Antiquities ...	9	9
Finance Ministry ... ..	2	69	
Total... ..		122	246

TABLE III.

NATURE OF SAMPLES.	Number of samples analysed.
Geological specimens (Ores, etc.) ... ..	99
Building materials ... ..	58
Paper... ..	69
Water ... ..	8
Miscellaneous ... ..	12
Total... ..	246

If samples of building materials used in all buildings and constructions of importance were systematically analysed, instead of only when



a dispute has arisen as to the quality of what has been used, many such disputes would probably be avoided.

At the Observatory, Mr. E. B. H. Wade has been in charge since the beginning of the year, as the former Chief Observer, Ibrahim Bey Esmat, was at first on sick leave, and when he returned to duty was unequal to carrying on the work of the Observatory. He retired on pension at the end of the year. The equipment of the Observatory is now complete as a First Order Meteorological Station, Atmospheric Pressure, Temperature, Humidity, Direction and Force of Wind, Duration of Sunshine being all recorded continuously by self-registering instruments. Time observations are made regularly for the control of the Standard Mean Time clock which automatically transmits the noon signal. This signal was sent regularly throughout the year, but it was not until October that the Telegraph Department had made the necessary arrangements to transmit it to out-stations. Since that month the Time Ball at Port-Said has been dropped automatically and also a signal sent to Wadi Halfa, but the arrangements to drop a ball at Alexandria and fire a gun at the Citadel, Cairo, were not completed by the end of the year. Hitherto Egyptian Civil Time had been 2 h. 5 m. 8.9 secs. fast of Greenwich time corresponding to the position of the Abbassia Observatory, while Port-Said and Suez used their own local time. From 1st September, 1900, Universal Time was employed, and since that date Civil Time for Egypt has been that of the 30th Meridian East of Greenwich, or 2 hours fast of Greenwich Mean Time. The Milne Seismograph has worked regularly throughout the year, but Magnetic Observations at Helwan had to be interrupted there being no observer available to make them during the last 6 months of the year.

H. G. LYONS.

# REPORT ON THE TECHNICAL DEPARTMENT

1900

BY

MD. ANIS BEY,

*CHIEF OF TECHNICAL DEPARTMENT*



## TECHNICAL DEPARTMENT.

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### YEARLY REPORT. 1900.

The work of the Steam Engine Service was carried out during the year 1900 under very much the same conditions as in the previous year.

153 demands for Tokhsas were received during the year; 110 were granted and delivered and 43 remained under consideration. Of the 110 Rokhsas delivered, 103 were for steam engines and 7 for gas and oil engines.

209 visits of inspection were made to 131 boilers. 23 of these boilers were condemned, and 108 proving satisfactory were granted the certificate of test and allowed to work.

A certain number of boilers in irrigation pumping stations were also examined and tested at the request of the Irrigation Inspectors.

No compulsory inspection has been made during the year, and, with the exception of new machinery put down, almost all the demands for Rokhsas were voluntary on the part of the owners.

Six cases of contravention were, however, submitted to the Courts during the year :

Mixed Courts (2). { One was sentenced to a fine.  
                                  { One was ordered to stop.

Native Courts (4). { One was sentenced to a fine.  
                                  { One was acquitted.  
                                  { Two are awaiting trial.

One explosion took place during the year, and that was in the case of a boiler of a pumping engine for irrigation.

Although the inspection of these boilers is not at present taken up by the Service, the causes of this accident were examined and reported on. The boiler was found to be very old and patched, and eaten away by corrosion both from inside and outside of shell.

Now the new law regarding the steam engines mentioned in my last report has (on the 5th of November) definitely passed; it is hoped that we shall no longer be in doubt as to the course that should be taken to enforce its regulations and insure the more satisfactory working of the Service.

By the provisions of this law only engines regularly authorized since the 27th of June, 1896 (the date of the old Layha), can be considered in order; the rest, if not duly declared by their owners to

the Ministry of Public Works within 60 days from the date of publication of the New Layha in the official papers, will be considered as newly established without Rokhsas, and their owners will be liable to be prosecuted before the courts and condemned to have their engines stopped.

The number of industrial engines known to the Service is about 1,500. Of this number 540 were duly authorised after the 27th of June, 1896, and 74 were declared since the issue of the Layha: the owners of the rest, being about 886, are now liable to prosecution unless they conform to the rules and get their Rokhsas in due form.

To facilitate this course the fees are abolished, the distances, which were a constant cause of annoyance, have been reduced, and the great thickness of the boiler-room walls is only imposed where actually necessary.

Under these circumstances, I do not think it can be considered inconvenient for these engine owners to put themselves under the present regulations.

As the introduction of this new Layha will throw a great amount of extra work on the Service, its staff is increased this year (1901) by one Engineer and two student Engineers.

I have much pleasure in stating that every one of this staff is doing his duty to my satisfaction.

Irrigation  
Fixed Engines.

The number of Rokhsas for Irrigation Fixed Engines given from the Technical Service during the year 1900 was 24. This, with the 742 in hand before, brings the total number of effective Rokhsas in hand at the end of the year to 766. Their distribution among the different irrigation circles is as follows :—

	Exchanged in 1900	Given in 1900.	Effective at the end of 1899	Effective at the end of 1900.
1st Circle ... ..	0	5	204	209
2nd Circle ... ..	6	15	285	300
3rd Circle ... ..	0	2	97	99
4th Circle ... ..	1	2	127	129
5th Circle ... ..	0	0	20	20
Guirga Directorate ...	0	0	9	9
	7	24	742	766

The fees received from the 24 Rokhsas were £E.211.

Quarries  
Service.

The Rokhsas for quarries (in Cairo and its vicinity) given by this Service to the end of 1899 were 627, 138 given for life and 489 for a period of 10 years.

From the latter 20 are cancelled, 17 by expiration of time and 3 by exchange, and 31 added during the year 1900. The number of 10-year Rokhsas will thus be 500, and the total number now in hand will be:—

Old Rokhsas given for life...	138
New Rokhsas given for 10 years	500
Total...	638

The fees received for the 31 new Rokhsas were £E.1,659,260.

The distribution of the quarries for which the 638 Rokhsas are given and the period of their expiry are shown in the following table:—

LOCALITY.	YEAR OF EXPIRY OF ROKHSAS												Rokhsas for life	Total Number of Rokhsas.
	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1929		
I.—Stone and Balut Quarries.														
Helwan.. ..	4	3	8	10	11	5	4	10	3	6	4		1	69
Ma'sara (el).. ..	9	5	14	3	2	5	—	4	5	4	—		3	54
Tura.. ..	2	2	1	7	1	3	5	—	2	—	—		29	52
Hashmy (el).. ..	—	1	—	—	—	—	2	—	—	—	—		5	8
Messan (el).. ..	—	—	—	1	—	—	—	1	—	—	—		—	2
Eyout Moussa.. ..	2	9	8	3	1	2	—	3	2	—	—		12	42
Harif (el).. ..	—	—	—	—	—	—	—	—	—	1	—		—	1
Emara (el).. ..	1	3	1	—	7	8	7	6	3	4	1		6	47
Metabbah (el).. ..	—	—	—	1	—	—	—	—	1	—	—		2	4
Tablita (el).. ..	—	3	4	1	1	1	—	—	—	—	—		—	10
Bassatin (el).. ..	—	—	—	—	2	—	—	1	—	2	—		—	5
Atar El-Nabi.. ..	6	3	9	7	—	—	5	5	2	—	—		8	45
Batu El-Bakari.. ..	3	4	7	4	—	3	3	3	3	5	1		11	17
Ein El-Sira.. ..	1	1	—	1	2	—	5	2	3	—	—		8	23
Abul Soud.. ..	1	2	—	1	1	—	1	—	—	—	—		9	15
Zawiet Nasra.. ..	6	2	2	4	—	2	3	9	10	2	—		11	51
Abiad (el).. ..	—	—	1	1	—	—	6	5	—	—	1		12	26
Ma adassa (el).. ..	—	1	1	2	—	3	1	8	—	2	1		13	52
Dewetka (el).. ..	1	—	2	1	—	1	3	1	3	3	1		4	20
Alumar (el).. ..	2	1	1	—	4	18	10	4	2	3	—		3	48
Khashab (el).. ..	—	—	—	—	—	1	—	—	—	—	—		1	1
	38	40	59	47	32	51	55	62	39	32	9		138	602
II.—Pebble-stone, and Sand Quarries														
Bab El-Nasr.. ..	—	—	—	—	—	—	—	—	—	1	—		—	1
Abbassieh.. ..	—	—	7	4	2	1	4	—	9	5	—		—	32
	38	40	66	51	34	52	59	62	48	38	9		138	635
III.—Gathering of Gypsum														
From Helwan to Kaid Bey, 3 zones.. ..	—	—	—	2	—	—	—	—	—	—	—		—	2
IV.—Extraction of Grog														
Ma'sara (el).. ..	—	—	—	—	—	—	—	—	—	—	—	1	—	1
	38	40	66	53	34	52	59	62	48	38	9	1	138	638

Central Stores.

I.—ORDERS GIVEN TO THE STORES:—

		Total.	
		£E.	£E. Mill.
1. For issue of articles...	...	148	
.. sale of articles ...	...	4	
		<u>152</u>	—
2. For receipt of articles	{ returned ...	75	
	{ purchased ...	35	
		<u>110</u>	—

II.—ARTICLES PURCHASED OR MADE:—

(A) *Furniture.*

		£E. Mills.	
1. Furniture made at the Arsenal. ...	...	112	455
2. .. purchased in Egypt ...	...	132	316
		<u>244</u>	771

(B) *Technical Instruments.*

		£E. Mills.	
1. Purchased from Europe	{ England ...	382	316
	{ France ...	60	056
		<u>442</u>	372
2. Made by Govt. Services	{ War Office ...	116	811
	{ Sc. & Watg. Service	1	425
	{ Arsenal ...	81	420
		<u>199</u>	656
3. Purchased in the country	...	109	400
		<u>751</u>	428
Grand Total ...	...	£E.996	199

III.—ARTICLES SOLD:—

		£E. Mills.	
1. To the Survey Department ...	...	15	990
2. To Mr. Willcocks ...	...	5	000
		<u>20</u>	990

IV.—REPAIRS TO TECHNICAL INSTRUMENTS.

	£E. Mill.
1. Repairs made at the Arsenal...	187 571

The value of the articles delivered from the Stores was £E.1185.311, distributed as follows:—

	£E. Mill.
Irrigation Department...	650 060
Building and Tanzim ...	203 810
Administrative Service ...	90 125
Technical Service...	132 111
Antiquity Service...	39 300
Survey Department ...	44 080
Reservoir Service ...	25 825
Total ...	<u>£E.1185 311</u>

The total cost of the work executed in the Arsenal Workshops and the materials delivered from its stores during the year amounted in value to £E.28,643 estimated as follows:—

	£E.
Materials for work executed in shops other than foundry ... ..	15877
Labour ... ..	5050
Castings (entered in and delivered from Stores) ... ..	2780
Transport ... ..	695
Coals, oils, etc., for steamers ... ..	2238
Percentage charged on work for indirect expenses ... ..	2003
Total ... ..	<u>£E.28643</u>

Of this amount the sum of £E.27523 was charged to the different branches of the Ministry of Public Works, £E.670 to other Government Departments, and £E.450 to private individuals.

The amount charged to the branches of the Public Works Department was distributed as shown in the following statement:—

	£E.
Irrigation ... ..	16482
Reservoirs ... ..	743
Building and Tanzim... ..	3121
Survey ... ..	1140
Service Administratif and other branches ... ..	551
Repairs to Steamers ... ..	2293
Maintenance of Arsenal plant ... ..	955
Coals, oils, etc., for steamers ... ..	2238
Total ... ..	<u>£E.27523</u>

As usual, most of the work done for the Irrigation Circles consisted of making pipes, grooves and timbers, the qualities and cost of which are shown in the following statement:—

	£E.
365 tons of iron pipes, including transport ... ..	9945
209 tons of C.I. grooves, including transport ... ..	2028
3333 pieces of Regulating Timbers, including transport. ... ..	2755
Sundry work and materials from Stores... ..	1754
Total ... ..	<u>£E.16482</u>

These iron pipes, which were from 20 centimetres to 2 metres diameter, were supplied at the rate of £E.17·6 per ton, including transport, and in the case of those of large diameter including also erection in place. In the previous year they were supplied at the rate of £E.14·85 and in the year before at £E.13·3. This increase in the rates is due to the great rise in the price of materials and fuel: plates which cost £E.8·5 per ton in 1898 cost £E.10 and £E.11 in 1899 and as much as £E.13 in 1900.



Notwithstanding this great advance in the price of materials, however, the Arsenal managed to keep the rate of cast-iron grooves and other castings almost at the same rate as the year before, i.e. £E.9 per ton delivered at the Arsenal, and £E.9.8 including transport and materials for fixing.

The Reservoir Service was supplied with cast-iron grooves and various other work for £E.670, and office furniture for £E.73.

The work executed for the Building and Tanzim consisted chiefly of making and repairing carts. The carts were supplied at the following rates :—

	£E.
Double water cart 2 cubic metres ... ..	42.5
Square water cart 1 cubic metre ... ..	19
Cylindrical water cart ... ..	18
Stone cart ... ..	9
Dust cart ... ..	8
Donkey cart ... ..	7

The Survey Department had a quantity of fittings for the Observatory and the Drawing and Lithographic office.

The Administrative Service and other branches of the Ministry ordered mostly office furniture and instrument repairs.

The work done for the maintenance of the Arsenal during the year cost £E.955, which was paid from the Arsenal economies. Of this amount £E.114 was spent in repairing the machines and tools in the shops; £E.106 in articles made for the use of the Arsenal and entered in store; and £E.725 in renewing three spans of the iron roof which were in a most dilapidated state; in making some modifications in the store buildings, and in white-washing, plastering and painting, and in general keeping the place in a satisfactory sanitary condition.

*Repairs to steamers.*—The steamers were all overhauled and more or less repaired to maintain them in a proper state of efficiency. The “Refic.” which was bought last year from the Police for £E.700 was completed and fitted at the cost of £E.584 for her hull and machinery and £E.111 for her deck fittings and stores. Her total cost all complete and ready for commission thus being £E.1395. She did service during the flood season in place of the “Messir.” The accident the “Nasratieh” met with on her trip to Upper Egypt in the early part of January, caused her to be taken in hand again for extensive repairs. The paddles had to be practically renewed, the engine floor plates strengthened, the staunchions repaired, and the back cabin refitted

again. The boiler, being in a bad condition, was lifted out of the boat and fitted with a new set of tubes after renewing a part of its tube plate. The cost of all these general repairs amounted to £E.456.

Our steamers being of too deep a draught for navigation during low Nile it was found necessary to have a shallow draught one for extraordinary service during the winter. A new stern-wheel shallow-draught steamer was consequently ordered from the Anglo-American Nile Steamer and Hotel Company in 1899 for the sum of £4130.

This steamer which is named "Dendera", was finished and received this year, most of her price being paid from the Arsenal.

The "Messir", owing to her old boiler and ancient type of engines is not now fit for ordinary commission. She is very expensive to keep on account of her large size and large crew necessary. She burns about 13 kantars of coal per hour, while the smaller and more useful steamers burn only from  $2\frac{1}{2}$  to 3. In my opinion it would be much more economical to sell her and buy a smaller one of a more modern type.

The total cost of repairs and deck fittings to steamers during the year amounted to £E.2293; the cost of coals and engine stores to £E.2238; and the cost of the crew to £E.1785. Thus the total expenses on the boats amounted to £E.6316 shown in detail as follows:—

STEAMERS.	Repairs.		Deck stores.		Coals, oils, etc.		Crew.		TOTAL.	
	£E.	M.	£E.	M.	£E.	M.	£E.	M.	£E.	M.
Nasratieh ... ..	405	071	51	503	185	737	322	341	961	652
Tahita ... ..	52	582	14	566	156	067	219	632	472	847
Messir ... ..	256	261	65	274	398	621	119	383	839	539
Cahira ... ..	43	821	27	211	179	261	140	816	391	109
Boulaq ... ..	—	—	13	859	366	527	213	—	593	386
Refic ... ..	583	891	111	273	131	851	81	400	908	415
Rekib... ..	228	567	27	584	117	365	184	475	557	991
Tawaf ... ..	67	155	12	603	113	928	133	760	327	446
No. 1 ... ..	34	243	17	105	341	052	138	567	530	967
No. 74 ... ..	9	226	0	831	49	680	73	600	133	337
No. 25 ... ..	0	288	1	319	98	722	82	850	183	179
Morris .. ..	188	658	17	370	47	455	21	200	274	683
Dendera ... ..	20	717	6	119	11	738	—	—	68	934
Dredger ... ..	5	687	—	—	10	782	53	400	69	869
Total... ..	1896	197	396	917	2238	786	1784	424	6316	354

Arsenal Stores. The materials bought for the Arsenal Stores cost £E.17613; of this amount materials to the value of £E.5788 were ordered from Europe and £E.11825 from local Merchants.

The delay and irregularity in delivery of materials from Europe this year was rather inconvenient. The Arsenal had to wait for the reception of materials, and when received late it had to do the work as quickly as possible to insure delivery in time, and the consequence was that some of it did not turn out satisfactory and some was not delivered in due time. Just complaints were made on these points and steps are taken which I hope will prevent their occurrence again.

I am glad to say that the Chief Engineer of the Arsenal and all his staff have done their work during the year to my great satisfaction.

M. ANIS.

*Chief of Technical Department.* •

# RAPPORT DU SERVICE DES ANTIQUITÉS

POUR L'EXERCICE 1900

PAR

G. MASPERO

*DIRECTEUR GÉNÉRAL*



# RAPPORT DU SERVICE DES ANTIQUITÉS

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## § I. — SERVICE ADMINISTRATIF.

Le Service des Antiquités est chargé dans les provinces de conserver les monuments d'époque païenne ou chrétienne qui sont déjà connus de longue date, temples, tombeaux, ruines des cités, des forteresses et des couvents; d'empêcher les fouilles clandestines et de fouiller lui-même ou de concéder des permis de fouille aux Sociétés savantes et aux particuliers; enfin, de surveiller l'enlèvement du *schakh* sur les sites antiques et de recueillir, autant que possible, les objets ou les monuments que les travaux des paysans ramènent au jour. Afin d'accomplir sa triple besogne, il a partagé l'Égypte en circonscriptions administrées chacune par un officier indigène, qui a sous ses ordres un nombre de *ghafirs* variable selon les besoins du moment. Au début de l'année 1900, il comptait sept de ces circonscriptions: 1° celle de Zagazig qui comprenait à elle seule les six moudirihs et les cinq gouvernorats du Delta; 2° celle du Fayoum, pour les deux moudirihs du Fayoum et de Béni-Souef; 3° celle de Rôdah, pour les deux moudirihs de Minieh et d'Assiout; 4° celle d'Abydos, pour la moudirihs de Girgèh et pour la moitié Nord de la moudirihs de Kénéh; 5° celle de Louxor, pour Thèbes, rive droite, et pour la banlieue; 6° celle de Gournah, pour Thèbes, rive gauche, et pour la banlieue; 7° celle d'Edfou, pour toute la région située entre Erment et la seconde cataracte; la moudirihs de Gizeh était placée sous la surveillance directe du Directeur et des conservateurs du Musée. Cette division établie en un temps où l'agriculture et les voies de communication n'avaient pas reçu le développement qu'on leur voit aujourd'hui, ne répondait plus exactement aux nécessités de l'état de choses actuel. La nomination, en novembre 1899 et en janvier 1900, de deux inspecteurs européens, MM. Quibell et Carter, a fourni l'occasion de reprendre cette organisation en sous-œuvre et de la rapprocher davantage aux conditions présentes du pays. Toutefois, comme le budget établi pour l'exercice 1900 ne prévoyait pas les fonds nécessaires à cet effet, la réforme dut être restreinte aux mesures qui n'exigeaient pas une demande immédiate de crédits nouveaux.

*Inspecteurs en chef.* — Après entente avec le Comité d'Archéologie, le territoire égyptien fut partagé provisoirement en deux Cercles d'Inspection: le premier, de Qous et de Naggadèh à la seconde cataracte, fut placé sous les ordres de M. Carter, avec résidence à Thèbes-Gournah; le second, de Qous et de Neggadèh à la mer, fut confié à M. Quibell, avec résidence au Caire. Le budget de 1900 n'offrant point de frais de déplacement à ces deux officiers, il fallut, pour leur en fournir, recourir à notre fonds dit *des carrières*. L.E. 183, 985 ont couvert la dépense de leurs inspections du 1<sup>er</sup> janvier au 31 décembre 1900. Les instructions qui leur furent données leur enjoignaient de parcourir l'un après l'autre les districts rangés sous leur autorité, d'examiner et de porter sur la carte les sites qui renferment des ruines ou qu'on peut soupçonner d'en renfermer, de noter ceux qu'il serait utile de recommander aux savants qui désirent entreprendre des fouilles, de veiller à ce que les monuments fussent déblayés et tenus proprement et que les voyageurs n'y fussent pas molestés par les mendiants ou par les gardiens eux-mêmes, enfin, de prévenir ou de surprendre les fraudes dont le Service est victime de la part des drogmans et parfois des touristes. L'étendue de leur circonscription d'une part, et, de l'autre, l'insuffisance des voies de communication, les ont empêchés de remplir complètement ce programme. M. Carter n'a pas encore visité la Nubie, faute de savoir comment atteindre les localités placées hors la portée des bateaux-poste: il n'en a eu que plus de loisir pour ordonner les deux inspectorats de Thèbes et pour les conduire presque militairement. M. Quibell n'a parcouru de façon méthodique qu'une portion des inspectorats situés au sud du Caire et c'est à peine s'il a eu le temps de pousser quelques pointes rapides à travers le Delta. L'influence des deux inspecteurs en chef ne s'en est pas moins fait sentir de la manière la plus heureuse sur l'ensemble du pays, et les résultats obtenus par eux avec les moyens restreints dont ils disposent nous sont un garant de ce qu'ils sauront faire lorsque le Gouvernement nous aura donné l'argent nécessaire à leurs déplacements: il serait à désirer de plus que M. Carter eût pour ses inspections de Nubie un canot à vapeur qui lui permit d'explorer librement la vallée entre les deux cataractes et de séjourner longuement dans les localités les moins peuplées. D'autre part, l'expérience de cette année a démontré que c'était trop peu de deux inspecteurs en chef pour assurer la sécurité du Service; il faudra modifier la limite commune des deux inspectorats existants, faire du Delta un troisième cercle d'inspection, et des mesures ont été déjà prises pour régler ces points en 1901, sans qu'il soit besoin d'augmenter grandement notre budget.

*Inspecteurs locaux.* — Bien que les officiers indigènes du Service eussent tous des fonctions identiques, ils portaient deux titres différents : les uns, celui d'*inspecteur (moujattich)*, les autres celui de *surveillant (moulahiz)*. Une décision du Comité d'Archéologie, sanctionnée par le Ministère des Travaux publics, leur a conféré à tous le titre d'*inspecteurs*.

L'inspectorat de Zagazig est trop considérable, et celui de nos officiers qui l'administre, Ali effendi Habib, a dû déployer une activité extraordinaire pour y maintenir l'ordre : il eût été utile de le subdiviser dès à présent en quatre circonscriptions, mais, comme cette opération eût exigé l'ouverture d'un crédit nouveau, elle a été différée jusqu'en 1901. A l'autre extrémité de la vallée, l'inspectorat d'Edfou s'allongeait très loin dans le Sud, et le site important de Philæ, ceux de Kalabshèh, de Dakkeh, d'Amada, d'Ibsamboul, la Nubie entière, demeuraient livrés sans contrôle à de simples gardiens. Deux postes d'inspecteurs de troisième classe étaient prévus dans notre cadre, mais ils étaient vacants : on s'en est prévalu pour rétablir les anciens inspectorats de Dendérah et d'Assouân qui avaient été supprimés il y a quelques années et pour alléger d'autant l'emploi des inspecteurs d'Abydos et d'Edfou. L'inspectorat nouveau d'Abydos ne possède plus que la moudirièh de Gîrgeh, et celui de Dendérah comprend la partie septentrionale de la moudirièh de Kénéh. L'inspectorat d'Edfou a conservé le terrain qui s'étend de Gébéléin aux environs de Deraou, et celui d'Assouân a pris, avec le canton de la première Cataracte, la Nubie entière. Quelques mutations de résidence ont accompagné ces remaniements de territoire : bientôt les inspecteurs anciens, stimulés par les instructions venues de Gîzèh et par les rondes répétées des inspecteurs en chef, ont déployé une activité inusitée jusqu'à ce jour chez la plupart d'entre eux. Les inspectorats d'Edfou, de Zagazig et de Rodah avaient toujours été tenus convenablement par leurs chefs, Aly effendi Habib, Mahmoud effendi Mohammed et Mohammed effendi Chabân : celui de Dendérah s'organisa rapidement sous la direction intelligente de Sobhi effendi Arif, et celui du Fayoum, où le désordre était au comble reprit quelque tournure grâce au zèle de Mohammed effendi Dohéir. Il reste beaucoup à faire encore avant que le service des inspecteurs ait repris toute la vigueur et toute la souplesse désirables : néanmoins, le progrès est assez sensible partout pour qu'il y ait lieu de s'en montrer satisfait.

*Gardiens.* — Il y a dans le Service des Antiquités deux sortes de *ghaïms*, les uns institués à titre permanent et inscrits sur les listes du personnel hors cadre, les autres nommés provisoirement pour des



périodes de temps qui peuvent varier de quelques jours à quelques mois, et qui sont payés pendant la durée de leurs fonctions par des Compagnies ou par de simples particuliers. Il sera question de ces derniers quand j'en viendrai aux faits relatifs à la prise du *sebakh* : je me bornerai à parler des premiers pour le moment.

Le nombre des gardiens permanents a été de 191 pendant l'année 1900. Pour les signaler à l'attention des voyageurs ou des autres agents du Gouvernement, ils ont reçu chacun une plaque de fer émaillé portant un numéro d'ordre en chiffres arabes et en chiffres européens, et qu'ils doivent s'attacher au bras gauche quand ils sont de service : l'oubli ou la perte du brassard sont punis d'une amende. Les numéros se suivent du sud au nord, les premiers d'entre eux étant assignés aux ghafirs de Nubie et les derniers aux ghafirs du Delta.

Les gardiens permanents sont répartis à la surface du territoire égyptien et rémunérés comme il suit :

INSPECTORAT	Nombre.	PAIEMENTS EN LIVRES EGYPTIENNES.			
		Sur Ch. 1 § 2	Sur Ch. 2 § 1.	Sur le fonds des Touristes.	Sur le fonds des Carrières.
Zagazig ... ..	12	48	48	48	—
Fayoum ... ..	14	120	12	36	—
Rodah ... ..	24	89.400	18	117	—
Abydos... ..	12	36	24	93	—
Dendérah ... ..	14	12	12	144	—
Louxor ... ..	12	—	—	162	—
Gournah ... ..	36	12	144	284.400	27
Eldfou ... ..	8	24	—	72	—
Assouan ... ..	11	60	—	72	—
Gizeh ... ..	7	54	—	66	—
Sakkarah ... ..	34	198	—	312	—
Mit-Rahineh ... ..	7	42	—	60	—
Total... ..	191	695.400	258	1466.400	27

Le nombre de ces gardiens est assez considérable et pourtant il ne suffit pas à assurer de manière efficace le jeu du Service. Si l'on prend les localités le mieux partagées, comme Gournah et Sakkarah, et que l'on recherche quelle est l'étendue du terrain à garder, on voit que trente-six hommes d'un côté, trente-quatre de l'autre doivent surveiller plusieurs milliers de tombeaux, sans parler des monuments tels que temples ou pyramides, et cela de nuit plus activement encore que pendant le jour. Onze ghafirs seulement ont pour mission de protéger,

avec les grands sites d'Éléphantine et de Philæ, les temples de la Nubie de Philæ à Wadi-Halfa. Douze ghafrs sont chargés de la défense du Delta entier, moins la ville d'Alexandrie. Il faudrait pour bien faire, que le nombre total fût porté à trois cents, c'est-à-dire augmenté d'un tiers, afin que la surveillance pût s'exercer d'une façon sérieuse, sans exiger des employés un effort trop fatigant pour durer longtemps. Non seulement notre budget actuel est incapable de fournir à nos besoins, mais lorsqu'on étudie la répartition entre nos crédits des fonds assignés aux salaires, on est obligé de reconnaître que, pour faire face à nos affaires, nous devons imputer des dépenses permanentes sur des fonds entièrement aléatoires. Le plus gros des traitements, 1466 L.E. 400, est prélevé sur les sommes qui proviennent de la taxe des touristes, et nous ne savons jamais, quand l'année commence, si nous réussirons à payer nos gardiens jusqu'à la fin. Qu'une crainte ou une réalité d'épidémie éloigne de l'Égypte les étrangers pour une saison ou deux ; nous sommes contraints de licencier plus de la moitié de nos ghafrs, et d'abandonner une quantité de sites anciens aux tentatives des paysans ou des chercheurs d'antiquités.

Sauf dans des cas très rares, les salaires ne dépassent pas 1 L.E. par mois. Beaucoup n'atteignaient pas ce chiffre au début de l'année, mais on s'est efforcé de les y porter tous depuis lors, et seuls, quelques ghafrs placés dans des conditions spéciales ne touchent que 60 P.E. Si, dans les endroits où nous avons plusieurs hommes et où, par conséquent, on a pu établir une équipe de jour et une équipe de nuit, ce traitement est convenable, il n'en est plus de même dans les localités très nombreuses où nous n'entretenons qu'un gardien. La surveillance entraîne alors des fatigues excessives pour celui qui l'exerce, et malgré tout, elle n'est pas efficace : comme elle ne peut pas se continuer pendant les vingt-quatre heures d'affilée, il faut bien la suspendre pendant une partie du jour ou de la nuit pour laisser reposer le surveillant. Or, les sites où la garde est intermittente de la sorte sont naturellement ceux-là auxquels les fouilleurs non autorisés s'adressent de préférence. Ils arrivent par bandes pendant l'absence du gardien, ou bien ils profitent de l'isolement de celui-ci pour essayer soit de le détourner de ses devoirs, soit de l'empêcher par la force de les remplir. La tentation est grande pour nos gens et ils y cèdent de temps à autre : il nous en a fallu renvoyer plusieurs qui s'étaient rendus au moins suspects de faiblesse ou de complicité. Toutefois ces défaillances ont été assez rares, et la plupart d'entre eux ont témoigné d'une honnêteté d'autant plus méritoire qu'elle les a exposés à des dangers réels. Quelques-uns ont été battus ou même blessés pour avoir tenté de s'opposer à des fouilles

clandestines ; d'autres, ayant fait usage de leurs armes, sans avoir observé toutes les formalités prescrites par la loi, ont été poursuivis eux-mêmes en justice et auraient pu être condamnés. J'ai dû expédier à tous les ghafirs des instructions qui, revisées obligamment par S.E. Corbet bey, procureur général auprès des Tribunaux indigènes, leur montreraient la manière d'accomplir leur devoir sans s'exposer eux-mêmes aux sévérités de la loi.

Le moyen le plus sûr de soulager notre personnel et de fortifier son action serait de l'augmenter dans une telle proportion que chaque poste comptât au moins deux titulaires, l'un pour le jour, l'autre pour la nuit. C'est ce qui a été fait en quelques endroits, mais, comme cet accroissement eût été hors de proportion avec les ressources existantes, le Service a demandé au Ministère de l'Intérieur de vouloir bien lui prêter le concours de ses agents. Par deux circulaires, l'une en date du 5 novembre (N<sup>o</sup> 74), l'autre en date du 26 novembre (N<sup>o</sup> 81) 1900, M. le Conseiller Machell, de ce Département, a prescrit aux mamours, omdchs, cheikh-el-beled, officiers et soldats de la police locale, en premier lieu de surveiller jusqu'à nouvel ordre les sites antiques où le Service n'avait point de gardiens, puis, dans les endroits où le Service entretient des agents, de leur venir en aide par tous les moyens légaux en leur pouvoir et de contribuer avec eux à la protection des monuments. Il est trop tôt encore pour apprécier les effets matériels que ces deux circulaires ont exercé sur la sécurité des monuments : l'effet moral a été excellent, en ce qu'elles ont prouvé aux autorités de tout rang que le Gouvernement prend intérêt au passé de l'Égypte et qu'il appuie les efforts que le Service fait pour en sauver les ruines.

*Vente des matériaux anciens et prise du sébakh ou de la terre sur les sites antiques.* — L'usage s'était établi, dès 1883, de vendre les débris de pierre, les briques cuites ou crues, les tessons, le sable, tous les matériaux antiques qu'on rencontre dans les tells et d'en passer le prix au compte du Musée : une décision du Comité d'Archéologie avait même attribué une destination spéciale aux fonds provenant de ces ventes, et on les avait affectés à couvrir les frais d'impression des ouvrages ou recueils de planches publiés par le Service. En 1897, le Ministère des Finances les avait réclamés pour le Trésor public, et, à la suite de négociations assez laborieuses, un accord était intervenu, d'après lequel le Trésor encaisserait l'argent provenant des ventes, tandis que le Service conserverait les Antiquités découvertes au cours de l'enlèvement des matériaux. Le Ministère des Finances a bien voulu, à la demande du Comité d'Archéologie, renoncer à toucher pour lui

cet argent et il a consenti à nous en rendre la disposition, comme devant. La liste provisoire des tells et koms principaux compris dans les limites de chaque moudirich a été dressée par les soins de la Direction, puis expédiée aux moudirs par le Ministère, avec ordre de veiller que la vente des matériaux s'opérât par les soins et au bénéfice du Service. Le prix en est fixé par la Direction, puis recueilli par les inspecteurs locaux et transmis au Ministère des Finances qui l'inscrit au crédit de notre compte *chakîs*. Les recettes de cette année, sans être des meilleures, nous ont permis, en premier lieu, de verser un à-compte de 300 L.E. sur une dette de 1300 L.E. contractée par M. de Morgan, ensuite de payer, comme nous le verrons au chapitre *Publications*, l'impression du deuxième fascicule du *Musée Égyptien* et de la seconde livraison du tome premier des *Annales*. C'est une ressource précieuse qui nous est rendue, et grâce à laquelle le Service sera bientôt en état de publier lui-même les principaux monuments découverts chaque année par ses agents au cours de leurs inspections ou de leurs fouilles.

Les tells antiques constituant les dépôts les plus considérables de *sébahh* qu'il y ait en Egypte, le Service des Antiquités a été chargé de surveiller la prise de cet engrais. Elle se faisait en général de manière assez irrégulière, et le nombre d'objets précieux, surtout de papyrus, qui ont été soustraits ou qui ont péri ou périssent tous les jours tandis qu'elle s'opère, est vraiment incalculable. Pour empêcher ou du moins pour restreindre ces pertes autant que possible, le Service exigeait que les paysans prissent l'engrais tous ensemble, sur des points déterminés, et sous la surveillance de ses ghafirs, dans les localités où il entretenait des ghafirs à demeure : où il n'en avait aucun, les paysans devaient se cotiser pour fournir le salaire d'un ou plusieurs ghafirs temporaires. Une tentative a été faite cette année pour coordonner toutes les mesures appliquées à cet objet dans les différents inspectorats, et un projet de règlement sur la prise du *sébahh* proposé à l'examen des divers Ministères que la question intéresse : il se trouve actuellement entre les mains de S. E. le Ministre de l'Intérieur, et l'on peut espérer que la décision ne tardera pas longtemps à intervenir.

## § II. — FOUILLES ET RESTAURATIONS.

Les fouilles sont de deux sortes, les unes entreprises par des particuliers ou par des Sociétés savantes dûment autorisées par le Comité d'Archéologie, les autres exécutées par le Service lui-même sur ses ressources ordinaires ou extraordinaires.

*Fouilles des particuliers et des Sociétés savantes.* — Comme la plupart de ces fouilles sont l'objet de publications rapides ou de rapports dans les pays auxquels appartiennent les savants qui les dirigent, je ne ferai qu'en signaler très brièvement ici la nature et les résultats.

L'Académie de Berlin a déblayé la plus grande partie du sanctuaire découvert en 1899, dans la plaine d'Abousir, entre Sakkarah et Gizèh. Les travaux dirigés par MM. Borchardt, Schæfer et Thiersch, aux frais de M. de Bissing, ont amené la trouvaille d'une très belle série de bas-reliefs représentant les cérémonies de la divinisation du Pharaon Sahouri, de la v<sup>e</sup> dynastie : le style en est très fin et la facture remarquable. Un dépôt de monnaies d'or et d'argent a été mis au jour pendant les fouilles. Les opérations ont repris au mois de décembre 1900 et elles continuent.

M. le marquis de Northampton a fait quelques sondages à Kom el Ahmar, près de Minieh, en décembre 1899 et en janvier 1900 : les résultats ont été nuls.

M. Gayet a repris dans les districts de Cheikh-Abadèh et de Cheikh-Saïd les fouilles qu'il dirige pour le compte du Musée Guimet. Il en a retiré un butin ordinaire de momies gréco-romaines avec leur bagage particulier de cercueils, d'étoffes brodées et teintées, d'objets de toilette et de chaussures ; rien de bien nouveau, mais un assez grand nombre de pièces intéressantes dans les données connues.

L'Institut Archéologique français a continué ses travaux à Méir pendant la meilleure partie de l'année. Il en est sorti très peu d'objets de musée, mais M. Clédat a copié la plupart des tombeaux de la vi<sup>e</sup> dynastie qui se trouvent là dans l'intention de les publier, et son ouvrage formera une contribution importante à l'histoire de l'art égyptien vers la fin de l'époque memphite. En décembre 1900, M. Chassinat a ouvert des chantiers nouveaux à Abouroach, au nord de Gizèh, et il a donné la preuve que la pyramide qui dominait jadis ce bourg avait été construite par le pharaon Dadoufri, de la iv<sup>e</sup> dynastie.

M. Flinders Petrie a repris pour le compte de l'*Egypt Exploration Fund* le site d'Abydos, occupé, de 1895 à 1899, par M. Amélineau. Il a retiré des rebuts qui provenaient des fouilles de ce dernier une immense quantité de débris de vases précieux, d'objets couverts d'inscriptions et même une grande stèle qui porte le nom de double Marineït d'un souverain très ancien. M. Petrie pense qu'une partie des Pharaons dont il a exploré les tombes est antérieure à Ménès : si cela n'est point, on ne peut les classer ailleurs que dans la première ou dans la deuxième dynastie. Ce sont les monuments royaux les plus anciens que l'on connaisse jusqu'à présent en Egypte, sinon dans le monde entier.

*Fouilles du Service des Antiquités.* — Le Service s'est réservé le droit de faire des fouilles dans les endroits que les indigènes lui indiquent, de compte à demi avec eux. La plupart des opérations de ce genre ont été peu fructueuses : une seule, qui fut entreprise à El-Berchiéh, sur la demande du Copte Yasso Todros, a produit des résultats inespérés. Le conservateur-adjoint, Ahmed bey Kamal, qui avait été désigné pour la diriger, a mis au jour la tombe d'un des princes d'Echmounein, au temps de la XI<sup>e</sup> ou de la XII<sup>e</sup> dynastie, avec ses cercueils et son mobilier funéraire complet. Une campagne de quelques jours menée à El-Kaouadi par l'inspecteurat de Zagazig a produit trois statues médiocres d'époque Saïte.

Les seuls travaux de fouilles considérables que le Service ait entrepris l'ont été sur le site de Memphis et de ses nécropoles, à Mit-Rahynèh et à Sakkarah. A Mit-Rahinèh, le reis Higgazi a déblayé un ensemble de constructions étranges, où des statues de mauvais style grec et une inscription phénicienne étaient mêlées à des monuments égyptiens de bonne époque ptolémaïque. A Sakkarah, j'ai repris, après quatorze ans d'absence, le déblaiement complet des pyramides. Chaque tombeau royal de l'empire Memphite m'avait alors paru comporter, outre la pyramide centrale où la momie reposait, une enceinte rectangulaire, dallée, formant cour : une chapelle funéraire, attenante à la face est de la pyramide et renfermant les *statues de double* visibles ou cachées, un réseau de souterrains, ouvrant sous le dallage, tracé le long de la face nord ou sous cette face, et pouvant se replier vers l'est ou vers l'ouest. A ses deux extrémités, pour abriter les offrandes ou les personnes de la famille royale que le souverain daignait admettre auprès de lui ; enfin, des souterrains ou des tombes isolées pratiquées à l'ouest et au sud, parfois même une ou deux petites pyramides destinées à des reines ou à des princes du sang. Pendant mon premier séjour, j'avais essayé d'ouvrir les chambres intérieures : il fallait maintenant rechercher sur le terrain si l'idée que je m'étais faite des autres parties était juste, et je confiai le soin de cette vérification à M. Alexandre Barsanti, conservateur-restaurateur du Musée. Les travaux commencés en décembre 1899 ont été continués jusqu'en mai 1900, et ils ont justifié pleinement la théorie. Une partie du dallage et les traces du mur d'enceinte ont reparu, les souterrains ont été retrouvés, ainsi que la chapelle, aux places voulues, et si l'opération n'est pas achevée encore, c'est qu'il a fallu enlever et transporter à distance une couche de décombres et de sable qui atteignait parfois dix-sept mètres de hauteur. M. Barsanti a déployé dans cette tâche ingrate des qualités de patience et d'ingéniosité qu'on ne saurait trop louer. Il a vidé tout en la poursuivant des puits d'époque Saïte

et persane où personne n'était entré avant lui, et dont la profondeur variait de vingt-huit à trente-deux mètres. Les caveaux auxquels ils aboutissaient étaient couverts d'inscriptions empruntées au *Rituel des Pyramides*, et les sarcophages reposaient à leur place primitive : l'un d'eux, celui de Zamehibou, nous a livré un vrai trésor de bijoux en or d'une délicatesse de ciseau incomparable, le premier qui nous soit parvenu de ces siècles de déchéance. Un escalier en fonte, installé dans le puits de Psammétique et des couloirs reliant les trois caveaux entre eux ont facilité aux touristes l'accès de cette nécropole intéressante. Entre temps, des mesures ont été prises pour sauver de l'ensablement ce qui pouvait l'être des fouilles de M. Loret et trois des mastabas dégagés par lui ont été recouverts d'un toit et munis de portes. Il en a été de même du mastaba de Phtahhotpou. Enfin, des balustrades érigées le long des galeries du Sérapeum garantiront désormais les visiteurs de chutes dangereuses. Il nous a paru que le premier devoir du Service était de multiplier les lieux de visite, et de rembourser, en quelque sorte, aux visiteurs le prix du billet que nous leur imposons dans l'intérêt des monuments : nous nous arrangerons de façon que tous les tombeaux intéressants de Sakkarah, anciens ou nouveaux, leur deviennent accessibles progressivement.

Nous avons poursuivi le même objet à Thèbes : les temples de Médinet-Habou, celui de Ramsès III et celui de Khonsou, à Karnak, le Ramesséum, les hypogées de Sannozmou, de Pashodou, de Rakhmiri, de Nakht, ont été munis de portes. Le tombeau d'Aménôthès II a été aménagé de manière qu'on y pût laisser exposées sans danger la momie du Pharaon et quatre autres des momies qu'il renfermait : les neuf autres ont été transportées au Musée de Gizéh. Le mur qui enveloppe à moitié le temple de Louxor a été continué jusqu'à la hauteur du pylone oriental de Ramsès II, puis le grand Ramesséum de la rive gauche a été enclos d'un mur provisoire de pierre sèche. M. Carter, qui a dirigé tous ces travaux, a ouvert, non loin de Déir-el-Bahari, une syringe immense qui, peut-être, abrita la momie d'un des Montouhotpou de la XI<sup>e</sup> dynastie : le corps n'a pas été retrouvé, mais une statue superbe d'un style encore à demi barbare, représentant le souverain assis, chairs noires, manteau blanc, couronne rouge, dans le costume que les Pharaons revêtaient lors de leur cérémonie de divinisation.

*Travaux de la salle hypostyle et du pylone de Karnak.* — La catastrophe du 3 octobre 1899 avait entraîné la chute de onze colonnes dans la travée nord de la salle hypostyle des Ramessides, à Karnak : cinq autres colonnes avaient été tellement ébranlées qu'il était nécessaire de les démonter au plus vite, si l'on voulait éviter une ruine nouvelle.

Il parut aussitôt que la situation nous imposait trois séries d'opérations successives : 1<sup>o</sup> le démontage des cinq colonnes branlantes et l'enlèvement des monceaux de blocs qui représentaient les onze colonnes écroulées ; 2<sup>o</sup> l'examen de l'aire ainsi obtenue par des ingénieurs ou par des architectes délégués à cet effet, et la consolidation du sous-sol d'après leurs indications ; 3<sup>o</sup> le remontage des colonnes et la remise des lieux en l'état primitif. Un calcul rapide permit de penser que la première de ces trois séries pourrait occuper deux ans environ et coûter un peu plus de 4000 L.E. si nul incident fâcheux ne survenait au cours des travaux. Toutefois, comme trois au moins des colonnes ébranlées étaient dans une situation telle qu'elles risquaient de s'effondrer d'un moment à l'autre, je demandai au Ministère des Travaux Publics une avance de 300 L.E. sur le budget ordinaire de 1900 et, sitôt obtenue, le 10 décembre 1899, j'envoyai M. Legrain, à Karnak, sur l'avis de Sir William Garstin, avec ordre d'installer immédiatement les chantiers. En février et en mars suivants, la Caisse de la Dette consentit à m'accorder une somme de 2600 L.E. dont 700 devaient être employées à l'achat d'un matériel Decauville destiné spécialement aux travaux du temple. La campagne dura cent soixante-cinq jours entre le 10 décembre 1899 et le 24 mai 1900 : lorsqu'elle fut terminée, les cinq colonnes branlantes avaient été démontées en partie, de manière à ne plus former que des tronçons hauts de six mètres, les architraves qu'elles supportaient et dont une au moins approchait de 42 tonnes en poids, avaient été descendues sans accident et emmagasinées dans les terrains situés au nord de la salle hypostyle, ainsi que de nombreux fragments des colonnes écroulées. La besogne aurait marché plus vite, si, dès la fin de janvier, le massif septentrional du pylone qui borne la salle à l'ouest n'avait commencé à s'ébranler à son tour. M. l'architecte en chef Manescalco-Bey, appelé en consultation à Karnak dans les premiers jours de février, reconnut l'imminence du péril et proposa un plan de restauration pour lequel la Caisse de la Dette voulut bien voter un crédit nouveau de 1400 L.E. L'exécution en fut confiée à un ingénieur allemand du barrage d'Assouân, M. Ehrlich. Du 20 avril au 23 mai, il éleva entre les deux massifs du pylone en danger un étançonnage en bois à quatre étage qui, prenant son point d'appui sur la face nord du massif sud, tint fortement en place les parties chancelantes de la face sud du massif nord : un perré de pierre, surmonté d'un épaulement en sacs de sable, compléta l'appareil d'étayage le long de la face est. Le tout a subi victorieusement l'épreuve de l'inondation : et il y a lieu de croire que nous pourrions attendre sans inconvénient le moment où la Commission chargée d'étudier les fondations de la Salle Hypostyle viendra examiner également ce qu'il convient de faire pour consolider le massif nord du pylone.



Les dépenses occasionnées par les fouilles et restaurations entreprises sur notre budget propre se sont réparties ainsi qu'il suit sur nos différents comptes.

NOM DE LA LOCALITÉ	Compte Fouilles.	Compte Touristes.
	L. E. M.	L. E. M.
El-Kawadi. ... ..	14.995	—
Tell-Mokdam ... ..	11.235	—
Tell-Robe ... ..	4.590	—
Mit-Rahynéh ... ..	16.920	—
Zaouiét-el-Aryân ... ..	43.900	—
Sakkarah... ..	527.870	—
El-Hibéh... ..	4.237	—
El-Berchéh ... ..	11.940	—
El-Hamrah ... ..	3.400	—
Khawalid... ..	6.210	—
El-Ahaiwah ... ..	2.520	—
Kous ... ..	4.025	—
Bibân-el-Molouk ... ..	—	24.042
Déir-el-Bahari... ..	14.965	17.075
Ramesséum ... ..	—	97.960
Déir-el-Médinéh ... ..	—	7.355
Karnak ... ..	99.325	112.155
Kom-Ombo ... ..	—	26.202
Divers. ... ..	3.560	1.290
Total ... ..	769.692	286.079

Le crédit qui nous est accordé pour les fouilles monte à 1800 L.E., et le compte *Touristes* rapporte en moyenne 2500 L.E. chaque année. Le moindre en est appliqué aux travaux de fouilles et de restaurations : le gros en est employé à des achats d'antiquités ou de matériel, à des loyers de magasins, à de menues dépenses pour lesquelles les autres crédits de nos budgets ne fournissent point de contrepartie, surtout en salaires de ghaffirs. Il y a là une insuffisance de ressources à laquelle il conviendra de remédier à bref délai si l'on veut que le Service des Antiquités puisse accomplir ses devoirs de manière adéquate.

Le crédit total de 4,000 L.E., que la Caisse de la Dette nous a accordé pour la restauration de la salle hypostyle et du pylone de Karnak, a été réparti comme il suit entre MM. Ehrlich et Legrain :

**Compte Ehrlich (Pylone).**

	L.E.	Mill.
Achat de matériel... ..	900	619
Transport de matériel ... ..	50	280
Personnel spécial ... ..	399	695
Frais de déplacement et de montures du personnel ... ..	27	040
Divers ... ..	7	406
Total... ..	1385	040

Une partie du matériel acheté n'a pas été employée et reste à notre disposition.

**Compte Legrain (Salle Hypostyle).**

*Campagne 1899-1900.*

			L.E.	Mill.
Déblaiements ... ..	775	280		
Maçons ... ..	217	665		
Achat de matériel ... ..	844	524		
Transport de matériel ... ..	11	780		
Personnel spécial ... ..	34	680		
Frais de déplacement du personnel ... ..	30	260		
Divers... ..	18	350		
			1932	539

*Octobre-Novembre 1900.*

Déblaiements et maçons ... ..	155	241		
Achat de matériel ... ..	53	202		
Transport de matériel ... ..	31	275		
Personnel supplémentaire ... ..	29	310		
Transport et frais de déplacement du personnel ... ..	1	640		
			270	668
Total... ..			2203	207

En novembre-décembre 1900, M. Legrain a dépensé une somme d'environ 412 L.E. complétant le crédit total de 4,000 L.E. accordé pour cette année : le détail n'en avait pas été vérifié encore au moment où ce rapport a été écrit.

**§ III. — LE MUSÉE ET LES PUBLICATIONS.**

*Secrétariat.* — L'augmentation perpétuelle de la correspondance nous a obligés de demander deux employés nouveaux pour le secrétariat : malgré ce renfort, c'est au plus si nous avons réussi à nous tenir au courant. Les Archives du Service n'ont qu'un classement insuffisant qui ne va guère au-delà de 1880, et toutes les pièces de la direction de Mariette, si précieuses pour l'histoire de nos débuts, sont encore enfermées sans ordre dans des caisses. J'aurais voulu les classer, mais je ne l'ai pu, faute d'un employé disponible pour exécuter ce travail : il faudra le reprendre au moment où nous serons installés dans le Musée nouveau.

*Augmentation du Musée.* — Les collections se sont accrues de façon normale : 681 monuments y sont entrés (n<sup>o</sup> 34050-34730), du 1<sup>er</sup> janvier au 31 décembre 1900, provenant partie des fouilles et achats du

Service, partie des fouilles opérées par des savants étrangers avec l'autorisation du Service. Parmi ceux de la première série, on remarque le pyramidion d'Amenemhaït III (xix<sup>e</sup> dynastie, Dahshour), le grand sarcophage en bois d'El-Berchéh (xi<sup>e</sup> ou xii<sup>e</sup> dynastie), les sarcophages de Psammétique, de Péténisis et de Zannehibou (époque persane, Sakkara), le trésor de bijoux d'or de Zannehibou (époque persane, Sakkarah), le naos d'Osorkon (xxii<sup>e</sup> dynastie, Bubastis), un couteau en silex à poignée d'or acheté à Kénéh (i<sup>re</sup> ou ii<sup>e</sup> dynastie), enfin les neuf momies royales découvertes par M. Loret en 1899, dans le tombeau d'Aménôthès II, aux Biban el Molouk. Les achats d'antiquités ont monté en tout à la somme de 263 L.E. 390, dont 257.390 sur le compte *Fouilles* et 6 sur le compte *Salle de Vente*. Les monuments provenant des fouilles privées ont enrichi le Musée de nombreux objets appartenant à l'époque préhistorique et aux dynasties thinites (fouilles de MM. Reisner à Dêir et Flinders Petrie à Abydos), à la v<sup>e</sup> dynastie (fouilles allemandes, à Abousîr) et à l'époque gréco-romaine et copte (fouilles de M. Gayet, à Cheikh Abadéh), enfin d'une admirable série de papyrus démotiques et grecs découverts au Fayoum, par MM. Grenfell et Hunt. L'incendie du navire qui les portait l'ont privé des papyrus grecs qu'il avait confiés à l'administration des Musées royaux de Prusse pour les déchiffrer et les publier et qui provenaient des fouilles allemandes de l'année précédente : cette administration a offert au Service de l'indemniser de la perte subie au moyen de papyrus appartenant en propre au Musée de Berlin, et cette question d'indemnité sera prochainement résolue.

*Préparatifs de déménagement.* — En vue du transfert prochain du Musée de Gizèh au Caire, on a commencé l'emballage d'une partie des objets exposés dans les salles publiques ou enfermés dans les magasins. Environ dix des salles du premier étage, contenant les statuettes funéraires, les cônes, le menu matériel des tombeaux, les ostraca, les modèles de sculpture, ont été vidées et les monuments mis en caisse : deux cents caisses n'attendent qu'un signal pour partir. On a de même entrepris la consolidation de tous ceux des objets en bois qui auraient pu souffrir du transport, surtout des cercueils stuqués et peints ayant appartenu aux grands prêtres d'Ammon Thébain et qui proviennent de la trouvaille faite par M. Grébaut, en 1890, à Dêir-el-Bahari. La partie du travail terminée en 1900 a coûté 215 L.E. 242 prélevées sur le crédit spécial de 8500 L.E. qui nous a été accordé par la Caisse de la Dette pour les frais du déménagement.

*Bibliothèque du Musée.* — Le Comité d'Archéologie avait concédé à M. Loret une somme de 300 L.E., à prendre sur les comptes *Salle de Vente* et *Entrées* et destinée au développement de la bibliothèque. Cette somme avait été entamée à peine et elle demeurait presque entière à ma disposition. Dans le courant de l'année 1900, nous avons employé 219 L.E. 965 en achats de livres et 52 L.E. 650 en frais de reliure, soit pour l'ensemble 272 L.E. 615. Le Comité a bien voulu m'accorder un nouveau crédit de 300 L.E. sur le compte *Salle de Vente*, qui sera probablement épuisé presque entier en 1901. La dépense est forte, mais elle est nécessaire. La bibliothèque actuelle ne possédait en 1899 qu'un petit nombre des grands ouvrages et surtout des brochures nécessaires à l'étude de l'Égyptologie : les lacunes y étaient telles que j'ai dû faire les premiers achats presque sans ordre, selon les occasions qui s'offraient au Caire même, et selon les exigences immédiates des savants attachés au Service. Maintenant que les besoins les plus pressants ont été satisfaits, il sera utile de procéder avec plus de méthode. Il faudra en premier lieu nous procurer tous les livres nouveaux qui paraissent sur l'Égypte ancienne dans l'Europe entière, de manière à nous tenir au courant des progrès de la science presque au jour le jour. Il conviendra ensuite de rechercher chez les libraires d'occasion tous les ouvrages qui ont été publiés sur l'Égyptologie depuis la découverte de Champollion et dont beaucoup sont devenus assez rares. Je pense que 400 L.E. dépensées en trois ou quatre années suffiront à racheter l'arriéré et qu'ensuite une centaine de livres par an nous permettront de nous procurer les nouveautés.

*Publications du Service des Antiquités.* — A la fin de 1899, le Comité d'Archéologie avait décidé de continuer et de terminer les publications commencées à des dates diverses par les directeurs précédents. Elles étaient au nombre de trois : 1<sup>re</sup> Le *Musée Égyptien*, recueil de planches, fondé par M. Grébaut, et dont une première livraison consistant en dix-neuf planches sans texte avait paru en 1890 ; 2<sup>e</sup> le *Catalogue des Monuments et Inscriptions de l'Égypte Antique*, dont M. de Morgan avait donné trois volumes de 1894 à 1895 ; enfin, les *Annales du Service des Antiquités*, projetées par M. Loret, et dont la première livraison était sous presse depuis 1898. Le Ministère avait accordé pour les *Annales* un crédit de 200 L.E. qui se trouva périmé à la fin de l'exercice 1899 faute d'emploi : le Comité d'Archéologie voulut bien attribuer à l'achèvement de ces trois publications une somme de 800 L.E. prise sur le fonds des chakfs.

M. Grébaut, en lançant la première livraison du *Musée Égyptien* avait invité les acquéreurs à souscrire au volume complet pour le prix de 125 P.E., et beaucoup avaient versé cette somme : il y avait un engagement pris envers eux et qu'il importait de tenir d'autant plus promptement qu'ils attendaient depuis dix ans déjà. La seconde livraison a été exécutée, pour les planches, par M. Bäckmann, de Carlsruhe, qui avait déjà exécuté les planches de la première : le texte, commun aux deux livraisons, a été imprimé à l'Institut archéologique français du Caire. Le tout, tiré à 300 exemplaires, a coûté 113 L.E. 970. Le *Musée Égyptien*, dont le premier volume se trouve achevé de la sorte, ne sera pas continué de façon régulière, année par année : il en paraîtra une livraison de temps à autre, lorsque le hasard des fouilles aura fait sortir de terre assez de monuments remarquables pour en fournir la matière.

M. de Morgan avait publié trois volumes de son *Catalogue général* : un volume sur Assouân et la cataracte, le premier volume de *Kom-Ombo*, le premier volume de *Dahshour*. Il avait fait exécuter la plupart des clichés nécessaires à la publication du second volume de Kom-Ombo et du second volume de Dahshour : il a bien voulu, sur ma demande, rédiger pour chacun de ces ouvrages un court avertissement par lequel il informe les souscripteurs des conditions nouvelles dans lesquelles le Catalogue se poursuivait, et M. Holzhausen, le grand imprimeur viennois, qui avait mis sur pieds les volumes précédents, a bien voulu se charger également de ceux-ci. Dix feuilles de *Kom-Ombo* ont été tirées depuis le mois d'octobre 1900, et les premiers chapitres de Dahshour sont déjà en épreuves : il y a quelque raison de croire que l'impression des deux volumes sera terminée dans le courant de 1901. Aucun règlement de comptes n'est survenu encore à leur égard entre M. Holzhausen et le Service.

M. Loret, en prenant la Direction, avait réclamé la création d'un journal Egyptologique, où les découvertes faites par les agents du Service seraient exposées tout au long, à mesure qu'elles se produiraient, ou bien les résultats principaux indiqués sommairement selon les cas. Au moment de mon arrivée, trois feuilles du premier fascicule étaient tirées et trois autres à peu près composées : je hâtai le tirage de ces dernières, et la première livraison parut en mai 1900. La seconde, comprenant six feuilles comme la première, a été achevée en décembre 1900, et la troisième, de même étendue, sera prête pour mars 1901 : les trois réunies constitueront le premier volume de la collection. Il laisse à désirer encore en ce qui concerne la gravure d'un certain nombre de vignettes et la qualité du papier, mais j'espère remédier en

partie à ces défauts, dès le second volume. Les *Annales* formeront chaque année un volume de dix-huit feuilles in 8° au moins et de vingt-deux au plus, avec une quantité de vignettes ou de planches hors texte proportionnelle à l'importance des sujets traités. Elles ne contiendront aucun mémoire sur des points spéciaux de notre science, et elles ne feront pas concurrence aux journaux techniques tels que la *Zeitschrift für Ägyptische*, le *Recueil de Travaux relatifs à la Philologie et à l'Archéologie Égyptiennes et Assyriennes*, ou le *Sphinx*: on y lira les rapports des officiers du Service, et, autant que possible, la copie intégrale des inscriptions nouvelles. Le prix du volume a été fixé à P.E. 97 et la vente confiée aux libraires attitrés du service, Hiersemam, pour l'Allemagne, Quaritch, pour l'Angleterre, Ernest Leroux, pour la France; mais nous ne saurons les résultats qu'au milieu de l'année 1901.

La deuxième livraison, la seule qui ait été payée en 1900, a coûté 113 L.E. 970. La matière du second volume est déjà prête, et une partie des articles qu'il comporte a été livrée à l'imprimeur: je pense que nous réussirons à le faire paraître en entier pendant l'année 1901, et que la régularité d'apparition, une fois obtenue, se maintiendra aisément.

*La Commission de l'Inventaire général du Musée.* — Cette Commission, instituée en 1897 pour trois ans, sur un crédit de 6,000, L.E. avait joui d'abord d'une autonomie véritable: placée, en janvier 1900, sous l'autorité immédiate du Directeur général, elle a subi par la force des choses, une transformation presque complète.

Elle se composait, au 1<sup>er</sup> janvier 1900, de quatre membres seulement, MM. de Bissing et Schaefer (Allemands), M. Lange (Danois) et M. Lacau (Français): M. Quibell (Anglais), qui avait été nommé Inspecteur en chef du Service en novembre 1899, ne fut remplacé que le 10 mars 1900, par M. Edgard (Anglais). De ces cinq savants, quatre ont été payés sur le crédit spécial de L.E. 6,000, accordé par la Caisse de la Dette; le cinquième, M. Schaefer, a été payé sur les économies particulières de notre budget. Les travaux de la Commission auraient dû être terminés et l'Inventaire général du Musée aurait dû être remis au Service en octobre ou novembre 1900, selon le plan dressé à l'origine par M. Borchardt; toutefois, il était évident qu'il ne pourrait pas être prêt en temps utile. Les parties suivantes du Catalogue étaient rédigées déjà:

Borchardt, Monuments de l'Ancien Empire et sculpture égyptienne:  
Fr. de Bissing, Vases en terre cuite, en pierre et en métal:

Reisner. Amulettes, figurines de divinités, bateaux, etc. ;

Crum. Stèles et manuscrits coptes ;

Chassinat. Cercueils des grands-prêtres d'Amon ;

Quibell. Monuments préhistoriques et de l'époque thinite.

De plus, MM. Schafer et Lange avaient attaqué la série des stèles du Moyen-Empire, et M. Lacau avait commencé la description des cercueils et sarcophages de la même époque. Même en ajoutant quelques portions de Catalogue, rédigées par des savants étrangers à la Commission, M. Wilcken, par exemple, pour les stèles grecques, on arrivait à constater qu'un peu plus de la moitié en nombre des monuments du Musée étaient décrits : il faudrait pour achever l'œuvre entreprise, demander à la Caisse de la Dette, un délai nouveau et un crédit égal pour le moins à celui qui avait été accordé en 1897. Le Comité d'Archéologie s'émut de cette situation, qu'il avait été loin de soupçonner, et après un examen approfondi des faits, il reconnut à l'unanimité qu'il y avait lieu de continuer la rédaction de l'Inventaire, et, par suite, de réclamer un second crédit, mais en modifiant les conditions du travail, et surtout en exigeant du Service la publication rapide des volumes déjà publiés.

En conséquence des résolutions prises par le Comité, le Service a demandé à la Caisse de la Dette et obtenu d'elle : 1° L'autorisation de ne pas reverser au trésor, mais de conserver le reliquat du crédit de L.E. 6,000 qui avait été accordé en 1897, à condition de l'employer à l'impression des volumes du Catalogue ; ce reliquat s'est élevé à la somme de 1,563 L.E. 924 ; 2° la concession d'un crédit nouveau à prendre sur une somme de L.E. 4,000 qu'elle accorderait annuellement pendant six années consécutives pour travaux extraordinaires ; ce crédit devait s'élever à 2,000 L.E. par an, dont les reliquats seraient reversibles d'année en année jusqu'à achèvement de la rédaction et de l'impression. Une fois en possession de ces ressources, la Direction prit, d'accord avec le Comité d'Archéologie, un certain nombre de mesures qui lui semblaient de nature à hâter l'entreprise. Elle décida d'adjoindre aux membres permanents de la Commission, les employés du Musée et les savants étrangers, de passage au Caire, qui voudraient bien se charger, moyennant rétribution, de composer telle ou telle portion de l'Inventaire qui les intéresserait : elle décida aussi de commencer l'impression sans retard.

Ces deux décisions furent mises à exécution sur le champ. Dès le mois d'avril, MM. Ahmed Bey Kamal et Daressy, Conservateurs du Musée se mirent à l'œuvre, le premier pour décrire les stèles grecques du Musée, le second pour cataloguer les Ostraka : de plus,

M. Strzygowski, professeur à l'Université de Graz, qui était venu passer en Egypte l'hiver de 1900-1901, fut enrôlé au service pour trois mois et chargé d'inventorier les monuments byzantins et coptes que M. Crum avait laissé de côté. D'autre part, les volumes déjà rédigés de MM. de Bissing, Chassinat, Crum, Daressy, Schaefer-Lange furent envoyés à l'impression. Pour éviter les pertes de temps et aussi pour faciliter la correction d'ouvrages rédigés chacun dans une des langues savantes de l'Europe, il a été convenu que les auteurs pourraient choisir telle imprimerie qu'ils préféreraient, en Egypte ou dans leur pays d'origine : l'unité de format et de justification serait exigée de tous, mais pour le reste, il suffirait que le papier et les types employés ne différassent pas trop l'un de l'autre. MM. Chassinat, Crum et Daressy ont choisi l'Imprimerie de l'Institut Archéologique Français, qui est une succursale de la grande Imprimerie Nationale de France : MM. Schaefer-Lange se sont adressés à l'Imprimerie de l'Etat de Berlin, et M. de Bissing, à celle de Holzhausen.

Les choses ainsi réglées ont marché sans encombre jusqu'à la fin de l'année. M. Lange partit en octobre, ainsi qu'il en avait donné avis, et le 15 du même mois, M. Schaefer donna brusquement sa démission pour se consacrer entier aux fouilles d'Abousir, si bien qu'au 31 décembre 1901, la Commission se composait de trois membres seulement, MM. de Bissing, Edgard et Lacau. Aucun des ouvrages mis à l'impression n'était achevé à la même date : les *Vases* de MM. de Bissing et les *Ostraka* de M. Daressy en étaient à la moitié ; les volumes de MM. Crum et Chassinat ne comptaient chacun que deux feuilles terminées, et celui de MM. Schaefer-Lange en était à peine au début de la composition.

*Le Directeur général,*

G. MASPERO.

Louxor, le 14 février 1901.





# REPORT ON AGRICULTURAL LINES

1900

BY

A. J. COTTERILL.



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1 £ St. ... = 975000 milliemes ... = 2880 pies.

1 penny ... = 40625 .. = 12 ..

1 pie ... = 00833 pence... .. = 0<sup>m</sup><sub>m</sub> 339

1 millieme 0246 .. ... = 295 pies.

1 penny a mile... = 252<sup>m</sup><sub>m</sub> per kilom. ... = 12 pies per mile.

0395 .. ... = 100 .. .. = 474 ..

00833 .. ... = 621 .. .. = 1 ..

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## REPORT ON AGRICULTURAL LINES.

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*Cairo, 31st December, 1900.*

SIR WILLIAM GARSTIN, K.C.M.G.,  
*Under Secretary of State,  
Ministry of Public Works.*

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### AGRICULTURAL LINES.

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SIR.—I beg to hand you my annual report on the Egyptian Agricultural Lines.

From the annexed Table No. 1 it will be seen that 761 kilometres (470 miles) of line were originally given in concession to four companies in 1895, 1896, 1897 and that as much as 924 kilometres (574½ miles) have been laid and are being worked at the present moment.

The total lengths of line were opened:—

1897	...	...	...	...	...	...	...	...	878 kilometres (54½ miles).
1898	...	...	...	...	...	...	...	...	355 .. (221½ .. ).
1899	...	...	...	...	...	...	...	...	694½ .. (430 .. ).
1900	...	...	...	...	...	...	...	...	924½ .. (574½ .. ).

2. *Extent of Lines.*—The Mansourah-Mattarieh Company completed their lines and extensions in 1898.

The Economiques laid 127 kilometres (79 miles) of line this year and completed their system, which now measures 342 kilometres (212½ miles).

The Delta Company laid 81 kilometres (50 miles) during this year, and this brings the total length of their lines to 381 kilometres (236¾ miles).

This is already more than was originally mentioned in their Concession. This Company not only has 104 kilometres (64½ miles) under construction but is asking for 150 kilometres (95 miles) besides. When finished their total system will amount to 635 kilometres (394½ miles).

Their application to lay down lines in the Menoufieh Province has been received favourably by the Government.

The Fayoum Company has not been able to lay and open to traffic more than 22 kilometres ( $13\frac{1}{2}$  miles) during this year. This brings the total length of their lines to 92 kilometres (57 miles). About 34 kilometres (21 miles) of line will be opened to traffic early next year.

3. *Telegraphs and Telephones.*—The length of telegraph and telephone wire on each line is as below:—

	Kilometres.	Miles.
Mansourah-Mattarieh ... ..	109·8	68 $\frac{1}{2}$
Delta Light Railways ... ..	31·5	19 $\frac{1}{2}$
Chemins de fer Economiques ... ..	342	212 $\frac{1}{2}$
Fayoum Light Railways ... ..	138	85 $\frac{1}{2}$
	<hr/> 621·3 <hr/>	<hr/> 386 <hr/>

It is hard to believe that it is in the best interest of the Delta Company to work 381 kilometres of line with only  $31\frac{1}{2}$  kilometres of telegraph or telephone communication, though at present with the light traffic it may be done without danger.

4. *Level Crossings and Subways.*—The Delta Company have one level crossing with the Government Lines, and one subway crossing made, and one in course of construction. The Fayoum Company propose to make a subway at Edwa.

The Economiques have one level crossing with the Government lines, three overhead bridges and four subways. These seven constructions are said to have cost the Company £E.38,683 or £E.5526 on an average. The purchase of land required for the approach embankments from a large part of this outlay.

The cost of working and watching a level crossing is estimated at £E.200 a year.

The saving affected by these 7 bridges cannot be less than £E.1400, which means an interest of  $2\frac{3}{4}\%$  on the outlay.

In their Annual Report published in February 1900 the Company says that the danger and delay to trains at level crossings forced them to abandon their use.

The delegates of the Railway Congress held at Paris last September were almost unanimous in deciding that such level crossings were seldom economical and always a course of danger. The Engineers of the Light Railways of Europe were agreed in this.

5. *Cost of the Lines.*—According to the printed reports it appears that the Mansourah-Mattarieh lines have cost that Company £E.2285 per kilometre.

This includes everything, even the loss in working during constructions.

The Chemins de fer Economiques appear to have spent £E.1550 per kilometre on their lines (£1588).

This is exclusive of any outlay or loss incurred in financial operations in raising capital.

The numerous and large bridges that were required and the construction of overhead bridges, subways and telegraphs have made these lines necessarily more expensive than those of the other two Companies.

According to the figures given in the Report of September, 1900, the cost of the Delta Co. lines was only £E.948 per kilometre (£973).

If this includes everything the result must be considered as most satisfactory.

No information is forthcoming as to the cost of the Fayoum lines.

The ten Indian narrow gauge lines given in table (Dargeeling-Himalayan is omitted) appear to have cost £E.1270 per kilometre.

6. *Working expenses and ratio to gross Receipts.*—In Table III I give the working expenses of the four lines and their ratio to the gross receipts. From them we may fairly deduce:—

- (1) that an Agricultural line with a reasonably good train service cannot be worked at less than £90 per kilom. per annum, and
- (2) that during construction working expenses will be at least 73% to 80% of the gross receipts.

I am aware that there are lines in Austria the gross receipts of which are only £70 per kilom. and still the working expenses are 50% of them.

From the Administration Report on Railways in India, 1898-1899, I make out that of ten lines 362 miles in length, and chiefly 2'6" gauge, three of them had a deficit. The average gross receipts were £E.146 per kilometre (say £229 per mile) and the working expenses amounted to £E.107 per kilometre (£168 per mile).

The proportion of working expenses thus being 73% of the gross receipts.

7. *Government Guarantee.*—From what has preceded it is not difficult to show that the Government guarantee of £36 per kilometre is a Will-of-the-Wisp.



The guarantee is a promise of the Government to three Companies to make their net receipts up to £36 a kilometre, but only 60% of the gross receipts is allowed for working expenses.

That is with gross receipts amounting to £90 per kilometre the Company may spend £54, and £36 will be available to pay 3% interest on the £1200 which was the estimated cost of a kilometre of line.

During the trying time of the construction of the lines the gross receipts are possibly below £90 per kilometre, but by Art. 5 nothing will be paid until the lines sanctioned are completely laid.

It is not until their gross receipts rise to £150 per kilometre that the Company can hope to reduce the percentage of expenses to 60%: then their working expenses would be £90 per kilometre and their net receipts £60 per kilometre.

It is thus practically impossible for a Company to work their line in such a way as to avail themselves of the guarantee, and if they could do so, it would show that the line was useless.

8. *Passenger Rates*.—Attempts have been made by some of the Companies to introduce special cheap market tickets.

These have not been found to increase the traffic or the receipts.

The minimum rates are, however, very low, they are:—

Mansourah Company.	...	...	1	mm. per kil.	0.4	pence per mile.
Economiques	...	...	1.50	"	0.6	"
Delta Company...	...	...	1.125	"	0.450	"
Fayoum Company	...	...	1.38	"	0.552	"

The lowest rates of the Egyptian Government lines vary from 1.25 milliemmes per kilometre (0.500 pence per mile) for short distances in Lower Egypt to 0.5 mill. per kilometre (0.2 pence per mile) for long distances.

This latter rate may be taken as the average for 3rd and 4th class passengers on Indian lines (normal gauge), but on the narrow gauge lines it is about 0.25 pence per mile.

9. *Number of Passengers*.—From Table II it will be seen that the first three Companies average already nearly 4200 passengers per kilometre and per annum. This figure is most satisfactory, and exceeds all forecast that were made for the first three years working.

10. *Rates for Goods.*—Two Companies have introduced a special low rate of 2 milliemmes per ton per kilometre (0·8 pence per ton per mile) for transport of manure and in a few special cases, but in other respects the usual rates of the Government line (without extra station expenses) are charged.

11. *Accidents.*—No accident has been reported during the year by any Company, nor has one, as far as I know, occurred.

I will now give a few particulars of each line separately.

12. *Mansourah-Mattarieh.*—The Mansourah-Mattarieh Company completed their lines and extensions in 1898 but has this year published a report, and declared a dividend for the first time. By the Concession the Government guarantees for this line was an annual net receipt of £E.6100, i.e. 55·9 per kilometre, but only 45% of gross receipts were allowed for working expenses.

The gross receipts for year ending October, 1899, were about £E.14,800, and for year ending October 1900 they had risen to over £E.17,000, there is therefore no likelihood of the Company asking for the Government guarantee which would further only provide a dividend of a little over 2% on the capital.

It is not likely that the Company will ever be able to work with 45% of its gross receipts, but the line may be considered now in a very flourishing condition.

The effect of competition from water transport on the Bahr Saghir is very marked.

The receipts from goods is only half that of coaching receipts, whereas on the Keneh-Assouan line and Indian lines, they are about equal, and on the Government lines the receipts from goods are double the coaching receipts.

The average length of carriage of goods is 35 kilometres and this in itself stamps this line as a more profitable one for carriage of goods than the other lines, where the goods are not carried on the average more than 15 or 18 kilometres.

The Company is about to arrange for the transport of goods by water between Mattarieh and Port-Said. This will probably improve the through traffic and there is no reason to suppose that it will cause any competition to the proposed Salhieh-Port-Said line nor be harmed by it.

13. *Delta Light Railways, Chemins de fer Economiques.*—The Delta Light Railways have been incorporated with the Chemins de fer

Economiques, and thus when the lines applied for are all laid there will be one system having 977 kilom. (607 miles) of track.

This fusion will no doubt tend to reduce expenditure in “Direction and Staff.”

14. *Fayoum Light Railways*.—The Fayoum Company has not been able to lay and open to traffic more than 22 kilom. ( $13\frac{1}{2}$  miles) during 1900 year.

This Company has not made as good progress as it ought to have done in laying its lines, but in spite of this, it will be seen from the figures given in Tables II and III that its goods’ traffic is important and increasing, and that the gross receipts are £E.85 per kilometre and their net receipts are £6 per kilometre.

Should the Government decide to pay this Company any of the guarantee (although the lines are not completed) the amount would be £2 per kilometre and calculated thus:

$£36 - (£85 - 60\% \text{ of } £85) = 2 \text{ per kilometre.}$  The Company would get £2 per kilometre from the Government and would thus have £8 per kilometre to pay interest on £1200.

I have not been able to learn the amount of capital spent, but I believe the lines and rolling stock, etc., have cost the estimated amount.

It is somewhat regrettable that the promoters, rich men as they are, should have allowed the credit of this Company to get into such low water.

## CONCLUSION.

The object of the Government in giving these concessions was undoubtedly to cheapen the transport of produce and improve the communication generally in those parts of the country where the Government Railways had not penetrated. This object has been fully attained, for there is hardly a corner in the Delta that is not fairly accessible by rail. The cost of cotton transport has been greatly diminished, and the former attendant difficulties entirely removed.

Besides this, the actual value of a large quantity of land has been greatly increased, so much so that the Companys have found the greatest difficulty in tempting the owners to part with their land.

Hitherto the promoters of the Company have not reaped the same advantages as the proprietors and cultivators of the land served by these lines.

The decision of the Government to improve the terms of the repurchase of these undertakings will make it possible for the Companies to invest capital in the necessary rolling stock, and make other improvements and carry out the same without running the risk of having to sell their property at a considerable loss.

I have the honour to be, Sir,

Your obedient servant,

A. J. COTTERILL.

*P S*.—Since writing the above I have been supplied with figures which show that the Delta Light Railways have spent £E.1,093 (£1.120) per kilometre of line instead of £E.948 given on page 3.



## AGRICULTURAL LINES.

*Table No. II. DETAILS OF PASSENGER COACHING RECEIPTS. Annual Report, December, 1900.*

Number.	TITLE OF LINE.	Average length of line opened to traffic during year.	NUMBER OF PASSENGERS CARRIED.					RECEIPTS.		Year to which figures given refer.
			First Class.	Second Class.	Third Class.	Total.	Passengers per kilometre of line opened.	Average sum paid for each ticket.	Total coaching receipts.	
		Kilometers.						P.T.	£L.	
1	Mansourah-Mattarieh ...	1098	2404	52924	118577	173905	1317	2.43	11516	{ July 1899, { June 1900.
2	Delta Light Railways ...	363	61914	—	1170777	1532031	1222	1.81	27717	{ Jan. 1900, { Dec. 1900.
3	Chem. de fer Economiques	240	3368	83031	879630	966032	4025	2.12	20501	{ Oct. 1899, { Sept. 1900.
4	Fayoum Light Railway ...	86	3850	—	281150	285000	3311	1.55	4153	{ Jan. 1899, { Dec. 1900.
5	Ten Indian Lines ...	581	4431	17596	39731 1539353 4th class	1601111	2713	2.34	37512	{ Jan. 1899, { Dec. 1899.
6	Keneb-Assouan Line ...	2737	3710	9325	241720	257755	911	8.40	21693	{ Jan. 1898, { Dec. 1899.
7	Egyptian Govern. Lines...	1956	176229	987187	9927265	11281284	5768	5.95	671717	{ Jan. 1898, { Dec. 1899.

# AGRICULTURAL LINES.

Table No. III.

GOODS AND COACHING RECEIPTS.

Annual Report, December, 1900.

TITLE OF LINE	Average length of line opened to traffic during year.	Goods carried.	Receipts from goods.	Receipts from coaching.	Total Receipts.	Gross Receipts per kilom. of line.	Total expenditure.	Working expenses per kilom. of line.	Net Receipts per kilom. of line.	Rates of working expenses to gross Receipts
		Tons.	£E.	£E.	£E.	£E.	£E.	£E.	£E.	%
1. Mansourah-Mattarieh ... ..	109.8	34100	5632	11516	17148	157	10322	93.4	62.6	60
2. Delta Light Railways ... ..	363	176709	14853	27717	12600	117.3	33531	92.3	25	78.7
3. Chemins de fer Economiques ...	240	66653	8917	20501	29418	122.5	31712	132	9.5	107.7
4. Fayoum Light Railways ... ..	86	40653	2888	4453	7341	85	6800	79	6	92.8
5. Ten Indian Lines ... ..	584	—	37722	37512	85234	146	62600	107	39	73.3
6. Kench-Assouan Line ... ..	273.7	64500	24356	21633	46049	170.5	32859	120	50.5	71
7. Egyptian Government Line ...	1956	3055897	1412592	671747	2084339	1079	950429	485	594	45
Including renewals of line and rolling stock										...
										1158097
										—
										54.5





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